SERVICE MANUAL
DIGITAL STORAGE OSCILLOSCOPE
MODEL DSS5020A

KIKUSUI

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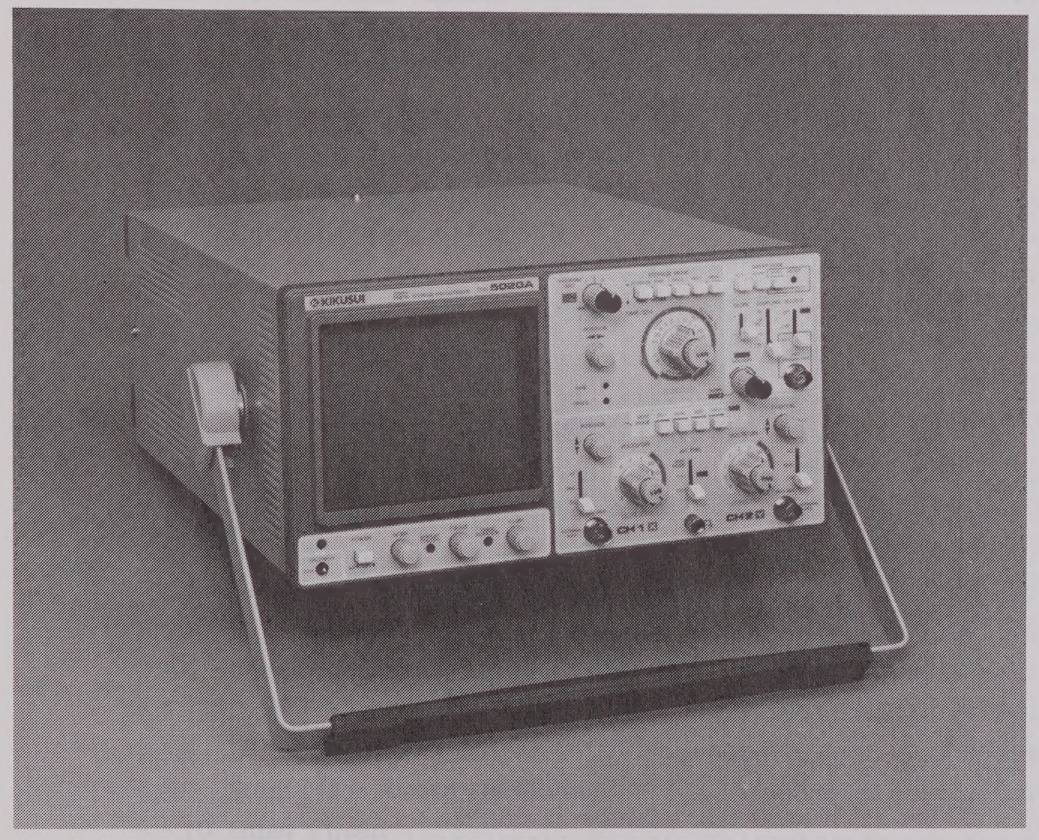
SERVICE MANUAL

DIGITAL STORAGE OSILLOSCOPE

DSS 5020A



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1. GENERAL INFORMATION

1.1 GENERAL

The DSS5020A is a portable dual-channel digital storage oscilloscope. It is incorporated with an 8-bit CPU, renders a maximum sampling rate of 1 MHz and an effective storage frequency of 400 kHz, has a memory capacity of 1024 words per channel, and is able to be used as a dual-channel digital storage oscilloscope with interpolation of data saved in the memory, or is able to be used as a real-time oscilloscope of 20 MHz. The most outstanding features of the DSS5020A are as follows:

1.2 FEATURES

(1) Effective storage frequency range of DC~400 kHz.
Interpolation can be done for both sinusoidal waves and pulse waves and consequently even one-shot sinusoidal waves can be accurately displayed.

(2) Wave form magnification
The saved waveforms can be displayed being magnified by up to 100 times, form one of three selectable points.

(3) PEN Out provision
The saved waveform data can be delivered with speeds which auto-matically changes depending on waveform, allowing you to obtain rapidly and accurately a hardcopy employing a pen recorder.

(4) Useful function
The various useful functions such as for comparison of waveforms and measurement of slow speed signals, one-shot events, and signals before the triggered point are incorporated.

(5) A trigger level lock function which makes triggering adjustment procedure unnecessary
A new trigger level lock circuit is incorporated. This circuit eliminated the requirement of troublesome triggering adjustment procedure not only for display of regular signals but also for that of video signals and large duty cycle ratio signals.

(6) 20-MHz dual-channel real time oscilloscope
The DSS5020A is a version of the COS5020 whose performance has been proven. The DSS5020A can be used as a quality real oscilloscope.

(7) Compact, light, but study
The oscilloscope is made of styren acrylonitrile butadiene and steel plates. It is compact, light, but sturdy.

2. SPECIFICATIONS

(1) Vertical axis

○ Non-storage mode (The same applies also to the storage mode unless specified otherwise.)

Item	Specification		Remarks
Sensitivity	NORM : 5 mV ~ 5 V/DIV ×5 MAG : 1 mV ~ 1 V/DIV		1-2-5 sequence, 10 ranges
Sensitivity accuracy	NORM : ±3% or better ×5 MAG : ±5% or better		10 to 35°C (50 to 95°F), 1 kHz, at 4 or 5 DIV Otherwise if in storage mode
Vernier vertical sensitivity	To 1/2.5 or less of panel-indicated value		
Frequency bandwidth	NORM : DC 2 ~ 0MHz, within −3 dB ×5 MAG : DC ~ 15MHz, within −3 dB AC coupling : Low limit frequency 10 Hz, −3 dB		With reference to 50 kHz, 8 DIV Otherwise if in storage mode
Rise time	NORM : 17.5 nsec or less ×5 MAG : 23.3 nsec or less		Otherwise if in storage mode
Input impedance	1 MΩ ±2%, 28pF ±2pF		
Display mode	CH1	CH1 single channel	
	CH2	CH2 single channel	
	DUAL	CHOP : 1 sec/DIV ~1 msec/DIV ALT : 0.5 msec/DIV ~ 0.5 μsec/DIV	
	ADD	CH1 ± CH2	
Chopping repetition frequency	200 kHz ±0.02%		Otherwise if in storage mode
Input coupling	AC − GND − DC		
Polarity change	CH2 only		
CH1 signal output	Approx. 100 mV/DIV when open ; approx. 50 mV/DIV when 50 - termination		
Maximum allowable input voltage	400 V peak (DC + AC peak)		AC : 1 kHz or lower

○ Storage mode

Item	Specification	Remarks
A/D converter	8-bit half-flush type	
Maximum sampling speed	1M samples/sec	
Vertical resolution	8 bits, 28 points/DIV, 9.14 DIV dynamic range	
Sensitivity accuracy	NORM: (±3%) + 1 LSB or better ×5 MAG: (±5%) + 1 LSB or better	
Effective storage bandwidth	NORM: DC~400 kHz ×5 MAG: DC~400 kHz	When sine interpolation is used.
Effective rise time	1.6 μsec or faster	When sine interpolation is used.
Chopping repetition	50 Hz~50 kHz, depending on TIME/DIV range	

(2) Triggering

○ Real mode (The same applies also to the storage mode unless specified otherwise.)

Item	Specification	Remarks
Signal source	INT, LINE EXT	
Internal triggering source select	CH1, CH2, and VERT MODE When in VERT MODE, triggering source depends on vertical channel being used. When in ADD mode, CH1 signal is used as triggering source signal.	VERT MODE is effective only when in ALT or Triggering is adjustable with LEVEL control.
Coupling	AC, HF REJ,TV, DC	
Polarity	+ or −	
Sensitivity	DC~10 MHz: 0.5 DIV (0.1 V) DC~20 MHz: 1.5 DIV (0.2 V) Video signal: 2.0 DIV (0.2 V) AC coupling: Attenuates signal components of lower than 10 Hz HF REJ: Attenuates signal components of higher than 50 kHz	The values enclosed in the parentheses are the input sensitivities when in the EXT triggering mode. The specifications of DC~10 MHz and DC~20 MHz are applicable to real mode only.

Item	Specification	Remarks
Triggering modes	AUTO: Sweep runs in the free mode when no triggering input signal is applied.	Meets trigger sensitivity specification for signals of 50 Hz of higher.
	NORM: When no triggering signal is applied, the trace is in the READY state and not displayed.	Otherwise if in storage mode
	SIGNAL: One-shot sweep with trigger signal. Can be reset to the READY state by means of lamp (LED) turns on when in the READY state or in the sweep operation.	Otherwise if in storage mode
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus. 0.5 DIV (0.05V). At sine wave (50 Hz~20 MHz).	Repetition frequency 50 Hz~400 kHz if in storage mode
EXT triggering signal input	EXT HOR input terminal is used in common.	Applicable to real mode only
Input impedance	1 MΩ ±2%, approx. 25 PF	
Maximum allowable input voltage	100 Vpeak (DC + AC peak)	AC: 1 kHz or lower

○ Storage mode

Item	Specification	Remarks
Triggering sensitivity	DC~400 kHz: 0.5 DIV (0.1V)	
Triggering modes	NORM: When triggering has become ineffective, the displayed waveform remains as saved with previous triggering and the circuit remains ready to accept triggering.	If in the ROLL mode, newly stored waveform is displayed even when in the READY state.
	SIGNAL: Waveform for one-shot sweep, cause by triggering is automatically saved. When saving is reset, becomes the READY state. The READY lamp (LED) turns on when in the READY state or in sweep operation.	If in the ROLL mode, newly stored waveform is displayed even when in the READY state.
Predelayed triggering point	Horizontal: 2 DIV, 5 DIV, or 8 DIV point	
Jitter canceller operating frequency	Approx. 50 kHz or higher	

(3) Horizontal axis (Time base)

○ Real mode (The same applies also to the storage mode unless specified otherwise.)

Item	Specification	Remarks
Sweep time	NORM: 0.5 μsec~1 sec/DIV ×10 MAG: 50 μsec~0.1 sec/DIV	1-2-5 sequence, 20 ranges
Sweep time accuracy (1)	±3%	10 to 35°C (50 to 95°F) Accuracy of sweep time for 8 divisions in graticule center
Sweep time accuracy (2)	±3%	10 to 35°C (50 to 95°F) When one time marker is assigned to each graticule division and the 2nd and 10th markers are aligned to the graticule lines, accuracy of each marker with respect to the 10 divisions, except the 1st and 11th markers.
Vernier sweep time control	To 1/2.5 or slower of panel-indicated value	Applicable to real mode only
Holdoff time	Continuously variable	Applicable to real mode only
Sweep magnification	10 times	
Magnified sweep time accuracy (1)	1 μsec~1 sec/DIV: ±5% 0.5 μsec/DIV: ±8%	10 to 35°C (50 to 95°F) Accuracy of sweep time for 8 divisions in graticule center, excluding 10%-portions from both end of sweep
Magnified sweep time accuracy (2)	1 μsec~1 sec/DIV: ±5% 0.5 μsec/DIV: ±8%	10 to 35°C (50 to 95°F) When one time marker is assigned to each graticule division and the 2nd and 10th markers are aligned to the graticule lines, accuracy of each marker with respect to the 10 divisions, excluding the 1st and 11th markers and 10%-portions from both end of sweep

Item	Specification	Remarks
EXT HOR mode	Trace swept by external horizontal signal applied to the EXT TRIG IN terminal. Vertical axis modes are CH1, CH2, DUAL and ADD modes (indicated).	Applicable to real mode only
Sensitivity	Approx. 0.1 V/DIV	
Frequency bandwidth	DC~1 MHz (−3dB)	
Phase difference between vertical axis	Within 3° (at DC~50 kHz)	

○ X−Y mode

Item	Specification	Remarks
Input	X−axis: CH1 input signal Y−axis: CH2 input signal	
X−axis sensitivity	Same as CH1 vertical axis	
Sensitivity	NORM: ±4% ×5 MAG: ±6%	10 to 35°C (50 to 95°F) 1 kHz, at 4 or 5 DIV
Frequency bandwidth	DC~1 MHz (−3dB)	
Y−axis sensitivity	Same as CH2 vertical axis	
Sensitivity accuracy	Same as CH2 vertical axis	
Frequency bandwidth	Same as CH2 vertical axis	
X−Y phase difference	Within 3° (at DC~50 kHz)	

○ Storage mode

Item	Specification	Remarks
Horizontal resolution	10 bits/channel, 100 points/bit, 1024 points	
Sampling speed	100 samples/sec~1M samples/sec	Sampling speed at 1 sec~1 msec/DIV depends on TIME/DIV setting. At 50 μsec~0.5 μsec/DIV, sampling speed is fixed at 1M samples/sec and wave-form is expanded by interpolation.

Item	Specification	Remarks
Accuracy of sampling speed	±0.02%	
ROOL mode	Automatic switching of 1 sec~0.1 sec/DIV range	
Time base magnification by interpolation	Up to 100 times of time base on which data has been saved (Up to 200 times when data is saved on 0.1 msec/DIV range) from the above time base	Magnification is done with reference to the portion selected by triggering point
Type of interpolation	Sine interpolation and pulse interpolation	
Processing time	Pulse interpolation Average: 0.067 sec/channel Maximum: 0.2 sec/channel Sine interpolation Average: 0.7 sec/channel Maximum: 2.4 sec/channel	
SAVE mode	As you press the SAVE switch, the oscilloscope is set to the SAVE mode and data being acquired is saved.	
REFERENCE	As you press the REF switch, data is stored with reference to the waveform currently displayed on the CRT screen. As you press the REF switch again, the REFERENCE sate is released.	Not applicable when in the DUAL mode
VIEW TIME	Approx.0.5 sec~5 sec, continuously variable	Excluding arithmetic processing time
PEN OUT function	As PEN switch is pressed when in SAVE mode, signal for displayed waveform is delivered. As PEN switch is pressed again, signal is reset.	
Output voltage	X−, Y−axis: 0.1V/DIV Sync: TTL, positive	
Output impedance	X−, Y−axis: Approx. 200Ω Sync: Approx. 470Ω	
Output voltage accuracy	±10% or better of value displayed on CRT	
Pen speed	Automatically variable for approx. 55 msec~4.4 sec in response to difference with respect to subsequent data	

(4) Z axis

Item	Specification	Remarks
Sensitivity	3 Vp–p (Trace become	
Frequency range	DC~5 MHz	
Input resistance	Approx. 5kΩ	
Allowable input voltage	50 Vpeak (DC + AC peak)	AC; 1kHz or lower

(5) Calibration voltage

Item	Specification	Remarks
Waveform	Positive square wave	
Frequency	1 kHz ±20%	
Output voltage	0.5 Vp–p, ±2%	
Output resistance	Approx.500 Ω	

(6) CRT

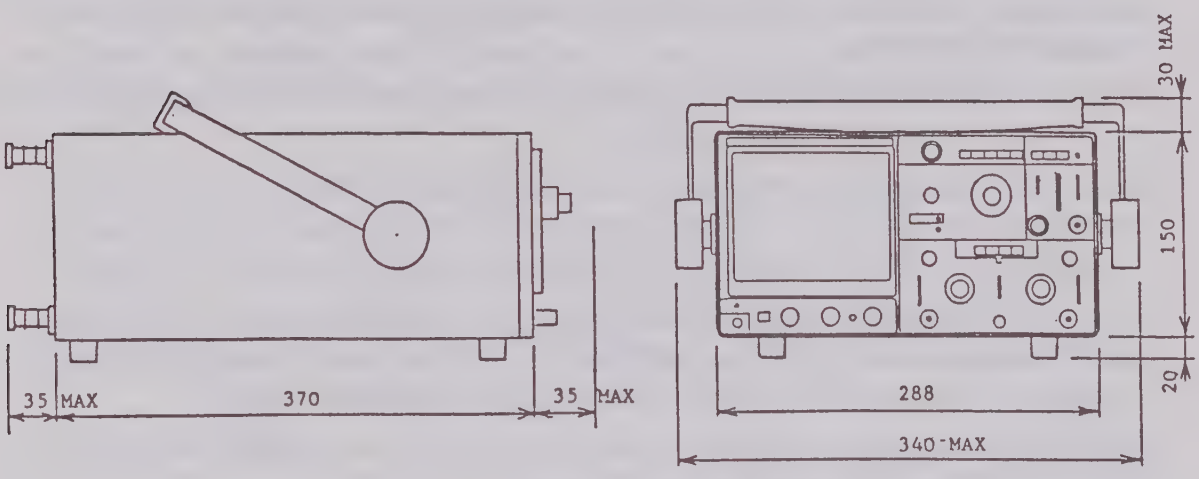
Item	Specification	Remarks
Type	6–inch rectangular type internal graticule	
Phosphor	P31	
Acceleration voltage	Approx. 2 kV	
Effective screen size	8×10 DIV	1 DIV = 10mm (0.39 in.)
Graticule	Internal graticule; continuously adjustable illumination	

(7) Line power requirements

Item	Specification	Remarks
Voltage range	90~110 V, 104~125V, 194~236V, 207~250V	Selectable by connector change
Frequency	50 Hz or 60 Hz	
Power consumption	Approx. 45 VA	

(8) Mechanical specifications

Item	Specification	Remarks
Dimensions	288W×150H×370D mm (11.37W×5.19H×14.57D in.)	Mainframe
	340W×200H×440D mm (13.39W×7.87H×17.32D in.)	Maximum
Weight	Approx. 7.4 kg (16 lbs)	



(9) Operating environment

To satisfy specifications: 5 to 35°C (41 to 95°F), 85% RH or less
Maximum operating ranges: 0 to 40°C (32 to 104°F), 90% RH or less

(10) Accessories

P060–S probes (10:1, 1:1, 1.5 m) 2
942A terminal adaptors 2
Power cord 1
Operation manual 1

○ Specifications and contents on this manual are subject to change without notice.

3 CIRCUIT DESCRIPTION

3.1 GENERAL

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 3-1. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for operating the cathode-ray tube, a data acquisition and processing circuit for digitizing and other processing of the signal, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying power to the various circuits of the instrument.

The vertical amplifier block has two mutually independent preamplifiers (CH1 and CH2), a channel selector, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stages. The conditioned vertical signals are sent to the channel selector. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1 and CH2 preamplifiers. The switched signals is fed to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the trigger generator.

The vertical output amplifier amplifies the vertical signal into a level of several tens volts for vertically deflecting the beam spot on the CRT screen.

The data acquisition and processing circuit has a microprocessor for logic control and arithmetic operations. With the A/D converter and acquisition logic, the waveform is stored in the main memory. The waveform data is transferred via the bus switch to the display memory. Then, with the D/A converter and store mode sweep generator, the digitally stored waveform is reproduced.

The horizontal deflection circuit has a trigger generator, sweep generators, a horizontal mode selector, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical channel selector or an external trigger signal from the EXT TRIG INPUT terminal and generates a trigger pulse signals.

The non-store mode sweep generator is driven by the trigger pulse signal of the trigger generator and produces a sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The horizontal mode selector circuit electronically selects the sawtooth signal of the non-store mode sweep generator, the sawtooth signal of the store mode sweep generator, or the CH1 HOR signal of the channel selector circuit depending on the operating mode of the instrument. The selected signal is fed to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal mode selector to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state. The HV regulator provides a −2.1 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it.

The Z-axis amplifier amplifies the unblanking signal received from the non-store mode sweep generator or CPU and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT circuit.

The CRT circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuits into levels suitable for application to the CRT.

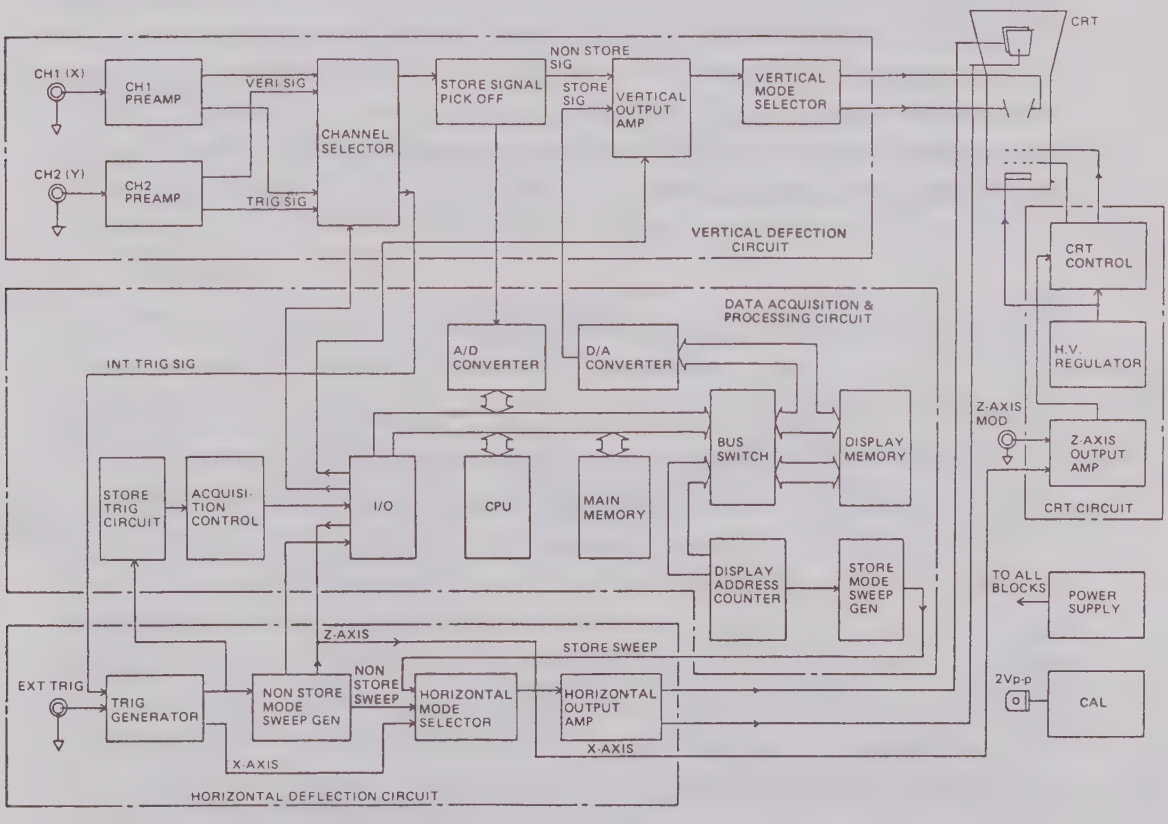


Fig. 3-1. Block Diagram of DSS5020A

3.2 VERTICAL DEFLECTION CIRCUIT

3.2.1 Preamplifiers

The CH1 preamplifier amplifies the signal of the CH1 or X input terminal. The CH2 preamplifier amplifies the signal applied to the CH3 or Y input terminal. A detailed block diagram is shown in Figure 3-2.

- Input coupling switch:

  The input coupling switch (S102/S202) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

- Attenuators:

  Each of the CH1 and CH2 attenuator circuits consists of two attenuators: The 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (S101/S201), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps.

  The 1st attenuator directly attenuates the signal received from the input coupling switch and feeds the attenuated signal to the voltage follower. The 2nd attenuator attenuates the low-impedance output signal of the voltage follower and feeds the attenuated signal to the 1st differential cascade amplifier.

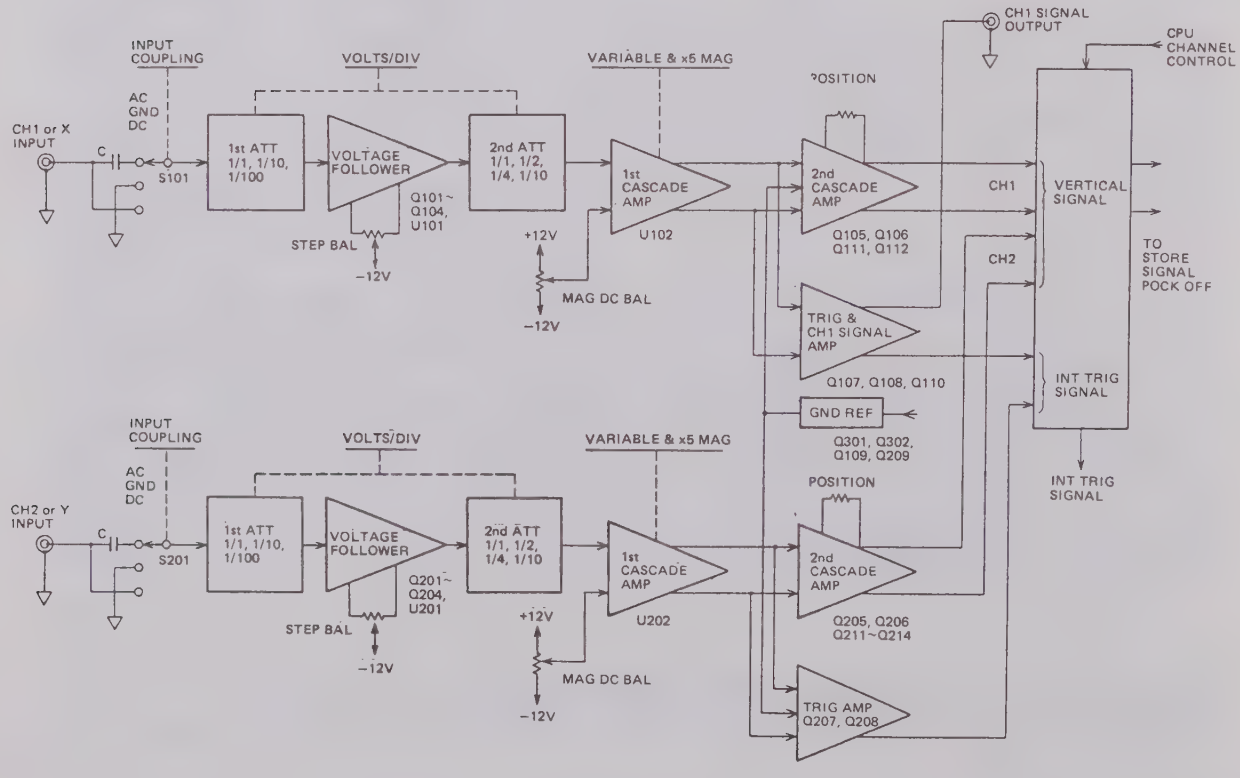


Figure 3-2

○ Impedance converter:

The impedance converter provides with its source follower (Q101/Q201) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (CH1 and CH2) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium grade thermally-coupled transistors.

○ 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (U102-1/2, U202-1/2) and a current-to-voltage converter (U102-2/2, U202-2/2) which converts the differential collector output current of the differential current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously-variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the x5 MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

○ VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer RV104/RV204 a part of the collector current amplified by U102-1/2 or U202-1/2. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

○ x5 MAG circuit:

The x5 MAG function is to increase the vertical sensitivity by 5 times by switching the emitter resistors of the 1st differential cascade amplifier.

○ 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q105, 106, 110, 111, or Q205, 206, 210 – 213) amplifies the output of the 1st differential cascade amplifier to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q110, 111/Q209 – 212) of this cascade amplifier has a function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 signal output amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity inverting function is accomplished by switching with the INV switch the base grounding stages of Q210/213 and Q211/212 to which the collector currents which have been current-amplified by Q205 and Q206 are fed in a crossing manner.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd fifferential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer RV111/211 of the positioning circuit.

○ Ground reference circuit:

As the GND REF signal is fed from the CPU when in the store mode, the output of the 2nd differential amplifier is shorted by Q109, 209, 301 and 302 to provide a ground level.

○ Trigger signal amplifier (& CH1 signal output amplifier):

This circuit amplifies with its Q107, 108/Q207, 208 the signal picked off from the 2nd differential amplifier, and converts with its Q109 the collector output of Q107 into a low-impedance CH1 output signal which is fed to J-6C. The collector output signal of Q108/Q207 is fed as a trigger signal to the internal trigger signal switching circuit.

3.2.2 Channel Selector

The channel selector is comprised of a vertical signal switching circuit (diode gate circuit) which electronically switches as dictated by CPU the vertical signals of the CH1 and CH2 preamplifiers and an internal trigger switching circuit which electronically switches the trigger signals.

The vertical signal switching circuit is, as shown in Figure 3-3, comprised of a diode gate circuit, an ADD BAL circuit, and a switching buffer circuit which receives the signal from the diode gate circuit.

○ Diode gate circuit:

The diode gate circuit (CR103 – 106, CR203 – 206) selects the CH1 and CH2 signals being controlled by the signal of the switching logic circuit according to the mode selected by the VERT MODE switch (S301).

For example, when the VERT MODE switch is set at CH1, the CH1 control signal becomes the Hi state, and the CH2 and CH3 control signals become Lo state. Consequently the output signal of the CH1 preamplifier is fed through CR103 and CR106 to the switching buffer circuit consisting of Q310 and Q311. The signals fo the other channels are fed through respective diodes (CR204/205) to the control circuit. Thus, the signal of CH1 alone is fed to the switching buffer circuit and the signals of the remaining channels are blocked.

○ ADD BAL circuit:

When the ADD mode is selected by the VERT MODE switch, the control signals of both CH1 and CH2 become the Hi state, the signals of the CH1 and CH2 preamplifiers are fed through CR105/106 and CR205/206 to the switching buffer circuit, and the two signals are fed as their sum signal to the output circuit. The function of the ADD BAL circuit is to compensate for the DC balance shift caused by the above addition operation, with its ADD BAL control (semi-fixed potentiometer RV301).

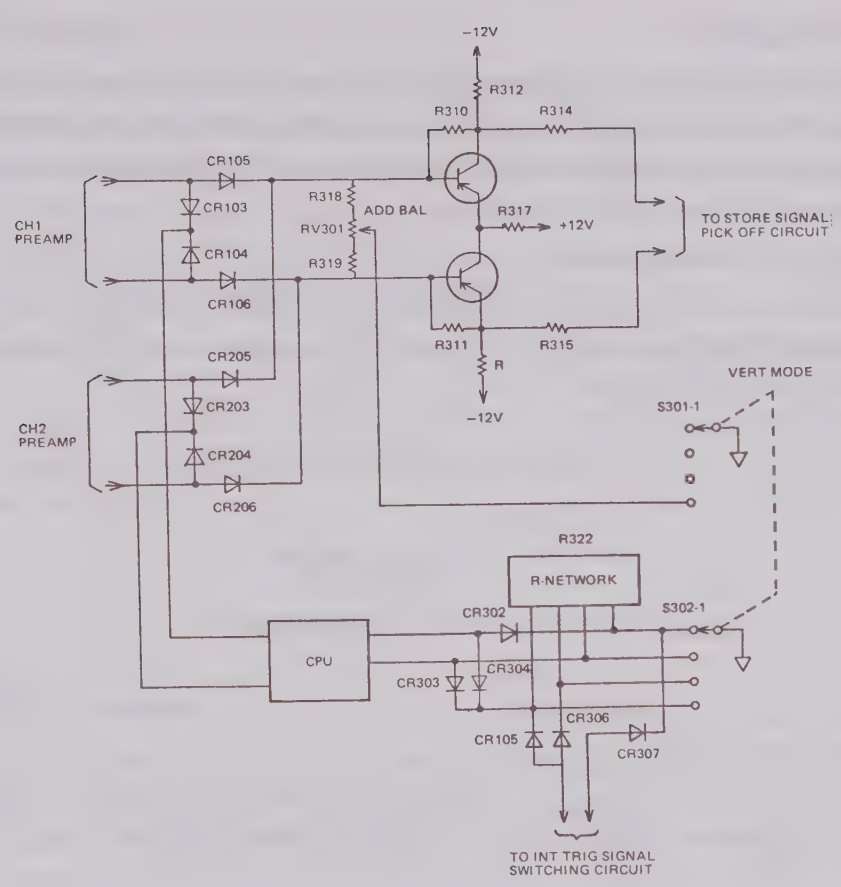


Figure 3-3. Channel Selector

○ Internal trigger signal switching circuit:

The internal trigger signal switching circuit directly controls, with the control signal from the channel selector, the diode gate circuit (CR107, 108, 207, 208) which is similar to the vertical signal switching circuit. The trigger signal which has passed the diode gate circuit is delivred as the internal trigger signal via connector P-7.

The channel selector controls the internal trigger signal switching circuit by switching it for the mode selected by the VERT MODE switch and TRIG SOURCE switch. This relationship is shown in the following table.

TRIG SOURCE / VERT MODE	CH1	CH2
CH1	Triggered by CH1	
CH2	Triggered by CH2	
DUAL	Triggered by CH1	Triggered by CH2
ADD	Triggered by CH1	Triggered by CH2

3.2.3 Vertical Mode Selector

The vertical mode selector selects whether the vertical signal which has passed through the display center circuit and store signal pickoff circuit is to be fed directly (when in the non-store mode) or after being digitally stored (when in the store mode) to the vertical output amplifier, as shown in Figure 3-4.

- Vertical mode switching circuit:

The vertical mode switching circuit has diode gates (CR801 – 808) similar to those of the vertical signal switching circuit. Switching is done with Q805 being dictated by the STORE/REAL control signal.

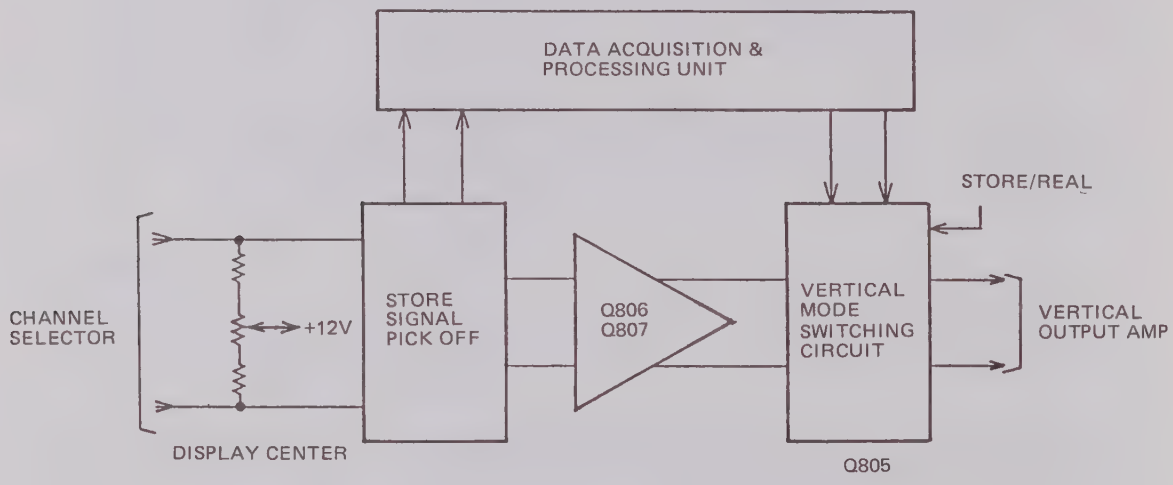


Figure 3-4 Vertical mode selector

3.2.4 Vertical Output Amplifier

The vertical amplifier is comprised of a drive amplifier and a final amplifier. The drive amplifier amplifies the signal received from the switching buffer amplifier and drives the final amplifier. The final amplifier amplifies the signal to a level sufficient for driving the vertical deflection plates of the CRT.

- Drive amplifier:

The drive amplifier (Q312, 313) is a feedback amplifier, with low output impedance for driving the final amplifier.

○ Final amplifier:

The final amplifier boosts the signal to a level sufficient for driving the vertical deflection plates of the CRT. It is comprised of a differential feedback-type SEPP amplifiers.

Transistors Q314, 315/Q316, 317 current-amplify the signal to a level sufficient for driving transistors Q314, 315/Q316, 317. The signal which has been voltage-amplified by transistors Q318, 319/Q320, 321 is returned to the input circuit through the negative feedback circuit (R345/R346). The gain in this case is as follows:

$$Av = \frac{R345}{R338} \qquad Av' = \frac{R346}{R339}$$

Transistors Q322/Q323 are for the dynamic bias circuit which controls the bias current with respect to the repetition frequency of the signal in order to economize current consumption.

3.3 HORIZONTAL DEFLECTION CIRCUIT

3.3.1 Trigger Generator

The trigger generator is comprised of a trigger pulse generator circuit which produces trigger pulse signal for driving the sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied.

The trigger pulse generator circuit of the trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT screen, a TV synchronization separator circuit which picks off the synchronization signal form the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

○ Source switch:

The source switch (S401) selects the internal trigger signal fed from Q401, the line trigger signal fed from R622, and the external trigger signal fed from P-14. The selected signal is fed to the coupling switch.

○ Coupling siwtch:

The coupling switch (S402-1) selects a coupling mode: It selects the DC mode for direct coupling of the signal fed from S401, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S402-2 selects ON or OFF of the TV synchronization signal separator circuit which facilitates viewing of a TV video signal.

○ Impedance converter:

The impedance converter is a source follower (Q403) with FET. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal, which is fed to drive the level comparator circuit (Q404, Q405).

○ Level comparator:

The level comparator is a differential amplifier (Q404, 405), which adjusts the rise up portion (or the fall down portion) of the comparator output signal by applying the trigger source signal (the base signal of Q404) from the impedance converter circuit and applying the comparator level signal (the base signal of Q405) from the LEVEL control potentiometer (RV402-1). In this case, if switch S407 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to the base of Q405 from the level lock circuit and the trigger point is set at the center amplitude of the trigger source signal.

The level lock circuit amplifies with its error amplifier (Q408, 409) the error signal detected by Q406 and Q407, and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

It also selects a slope by switching the comparator output with the slope switch (S403-1).

The output signal of the level comparator is fed to the buffer amplifier which operates also as a signal separator circuit.

○ Buffer amplifier/TV synchronization signal separator circuit:

This circuit operates either as a buffer amplifier or as a TV synchronization signal separator circuit, being selected by the transistor switching circuit (Q410, 411).

When Q410 is on and Q411 is off, the circuit operates as a buffer amplifier and amplifies the output signal of the level comparator to a level sufficient for driving the Schmitt circuit of the next stage.

When Q410 is off and Q411 is on, the circuit operates as a TV synchronization signal separator circuit and picks off the TV-H synchronization signal, which is pulsewidth-detected into a TV-V synchronization signal by the Schmitt circuit of the next stage.

○ TRIG Schmitt circuit:

The TRIG Schmitt circuit is a conventional circuit which generates a hysteresis voltage by applying a feedback signal with R440 to the two stages of NAND gates of U401. The output of the Schmitt circuit drives the A and B SWEEP generators and AUTO circuit.

The output signal is fed also to the data acquisition and processing circuit.

○ AUTO circuit:

The AUTO circuit is comprised of a uni-junction transistor (UJT) circuitry made up by connecting mutually the bases and collectors of a PNP transistor (Q414) and an NPN transistor (Q415). This circuit converts the high-speed pulse output signal of the Schmitt circuit into a DC signal, with which to drive the non-store mode of sweep generator.

3.3.2 Non-store Mode Sweep Generator

The non-store mode sweep generator is comprised of the sweep gate circuit which accepts the trigger pulse fed from the trigger generator and generates a sweep gate signal with which to start the sweep, the sweep start comparator which holds stably the start point of the sweep, the time base control circuit which dictates the time constant, the sawtooth sweep generator which generates the sawtooth sweep signal, the sweep length circuit which dictates the sweep length, the hold off circuit which controls the sweep return period and pause period, and the sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

- Sweep gate circuit:

The sweep gate circuit employs a flip-flop TTL IC (U402-1/2) with preset/clear function. The trigger pulse of the trigger generator is applied to the CLOCK (Pin No. 1) terminal, the enable signal of the sweep gate enable circuit to the CLEAR (Pin No. 15) terminal, and the enable signal and AUTO signal of the AUTO circuit to the PRESET (Pin No. 4) terminal through the NOR gate circuit. The Q (Pin No. 5) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (Pin No. 6) terminal output is fed to the sweep start comparator circuit and becomes the sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the PRESET terminal so that the sweep gate signal is generated and the circuit operates in the free-run mode.

- Sweep start comparator:

The sweep start comparator (Q422, 423) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. The start reference level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

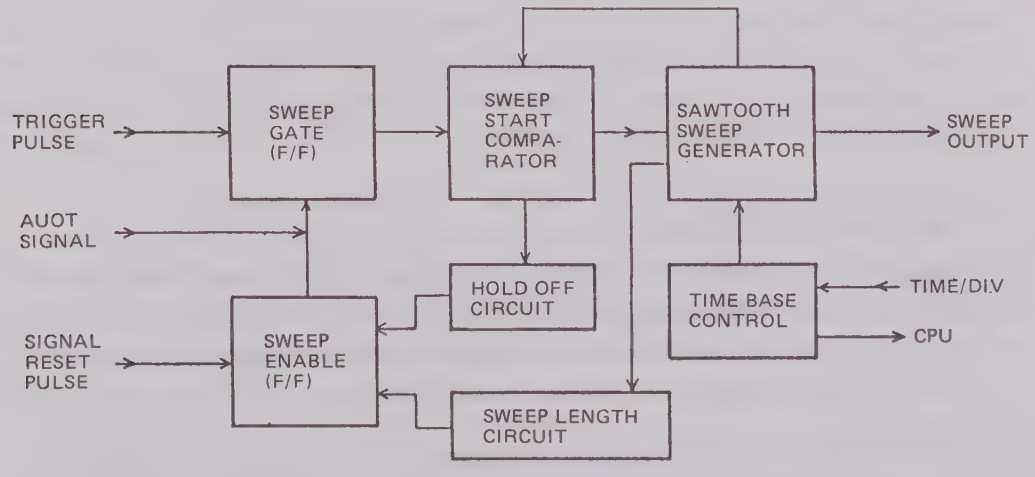


Figure 3-5 Non-store mode sweep generator

○ Time base control circuit:

The time base control circuit performs with its U406, Q433, Q434 a coding function on the time base signal selected by the TIME/DIV switch, decodes with its U405 the coded signal, and dictates the time constant of the return trace with U407, 408, and R484. The data coded by U406 and U409 is read as range data by CPU.

○ Sawtooth generator:

The sawtooth generator is comprised of a gate transistor amplifier and a Miller integrator.

The gate transistor amplifier (Q424) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q427) produces a sawtooth signal with the time constant selected by the time base control circuit.

○ Sweep length circuit:

This circuit divides the sweep generator output by R454/R455 and shapes the waveform with Q419 to obtain a sweep length signal.

○ Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with an integrator circuit and making use of the rise time of the triangular wave. The integrator, with its Q420, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the integrator circuit is shaped by Q418 into a holdoff signal.

○ Sweep gate enable circuit:

The sweep gate enable circuit employs the flip-flop IC (U402-2/2) which makes up a pair with the sweep gate circuit. The holdoff signal is applied to the PRESET (Pin No. 10) terminal, the length signal is applied to the CLEAR (Pin No. 14) terminal, and the enable signal is delivered from the Q (Pin No. 9) terminal. This enable signal presets or clears the sweep gate circuit.

When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle and a one-shot sweep is effected by the reset signal applied from the CLOCK (Pin No. 13) terminal.

3.3.3 Horizontal Mode Selector Circuit

The horizontal mode selector circuit is comprised of the switching buffer circuit which prevents the loading effect on the preceding stage with switching distortions, the display switching circuit which electronically selects between the store/non-store sweep signal and the CH1 HOR(X) signal, and the display switching circuit which controls the display switching circuit.

○ Switching buffer circuit:

The switching buffer circuit is a base-grounded amplifier. Transistor Q431 is for buffering amplification of the non-store mode sweep signal and transistor Q432 is for that of the store mode sweep signal.

○ Display switching circuit:

The display switching circuit selects between the store/non-store sweep signal and the CH1 HOR(X) signal with the analog signal multiplexer IC (U404).

3.3.4 Horizontal Output Amplifier

The horizontal output amplifier consists of a drive amplifier which selects between NORM and x10 MAG mode for the horizontal signal received from the horizontal mode selector circuit and drivers the output amplifier, and an output amplifier which drives the horizontal deflection plates of the CRT.

○ Drive amplifier:

The drive amplifier (Q501 – 504) converts the horizontal signal received from the horizontal mode selector circuit into a differential signal, with which to drive the output amplifier. With Q501 and 502, gain of the differential amplifier can be multiplied by a factor of 10 for the x10 MAG function.

○ Output amplifier:

The output amplifier (Q505 – 512) is comprised of feedback-type SEPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q505/Q506 is converted into a voltage signal by Q507 – Q512 to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R515/R517, stable gain and wide and flat frequency response are attained.

3.4 CRT CIRCUIT

3.4.1 Z-axis Amplifier

The A-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signal fed from the non-store mode sweep generator or CPU, the chopped blanking signal, and the external intensity modulation signal fed via the Z-axis input terminal. The output amplifier amplifies the merged signal to a level sufficient for driving the control grid of the CRT.

○ Input circuit:

The input circuit merges into a compound signal the unblanking signal fed from the non-store mode sweep generator or CPU, the chopped blanking signal (the chopped blanking

signal is always controlled by the CPU), the external intensity modulation signal fed via the Z-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

- Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is a feedback-type SRPP circuit (Q654, 656, 658). This amplifier also generates (with its Q655, 657, 659) a linear focus signal which is in the inverted phase of the unblanking signal. The amplified unblanking output signal and linear focus signal are fed to the G1 and P1 of the cathode-ray tube through the CRT circuit to drive the intensity and focus of the displayed waveform.

3.4.2 CRT Control Circuit

The CRT control circuit is comprised of a DC regeneration circuit which converts the linear focus signal and the unblanking output signal of the Z-axis amplifier into the operating-voltage signals of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers ASTIG (RV652), GEOMETRY and SUB-FOCUS (RV651), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

- DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respect to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

3.4.3 HV Regulator

The high voltage generator produces an acceleration voltage (−2100 V) applied to the CRT cathode. The circuitry is a DC-DC converter with a blocking oscillator (Q651) with resonance of the secondary coil winding. The high voltage of apporximately 4200 Vp-p (frequency approximately 30 kHz) is generated by the blocking oscillator and it is half-wave rectified into a negative voltage of −2100 V.

This DC-DC converter feeds the negative voltage via a high resistance circuit (R661, R662) to the control circuit (U651) to obtain a stabilized acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

3.5 DATA ACQUISITION & PROCESSING CIRCUIT

3.5.1 Introduction

The data acquisition and processing circuit is comprised of a microprocessor and acquisition logics which make up a control system, an A/D converter and D/A converter and memory which make up a data processing system, and other circuits such as trigger generator and store-mode sweep generator. A general flowchart is shown in Figure 3-6.

- Non-store mode:

  When power of the DSS5020 is turned on, the microprocessor reads the operation mode through the input port. If operation is in the non-store mode, the microprocessor selects the single channel or dual channel operation in the CHOP or ALT mode as set on the front panel, and controls the blanking operation.

- Store mode:

  When in the store mode, sampling speeds are changed depending on the TIME/DIV range data, and the waveform data is acquired, stored and displayed as shown in Figure 3-9.

  Individual circuits are described subsequently.

3.5.2 Microprocessor

The microprocessor is reset by the power on reset circuit, operates on the signal generated by the crystal oscillator, and accesses the DMA, I/O port, memory and other circuits following the program written in the ROM.

- Power on reset circuit:

  The power on reset circuit provides a time constant with C832 and R847 when power is turned on, and provides a $\overline{\text{RESET}}$ signal which is fed via the buffer (U815-2/4) to the microprocesosr and CTC.

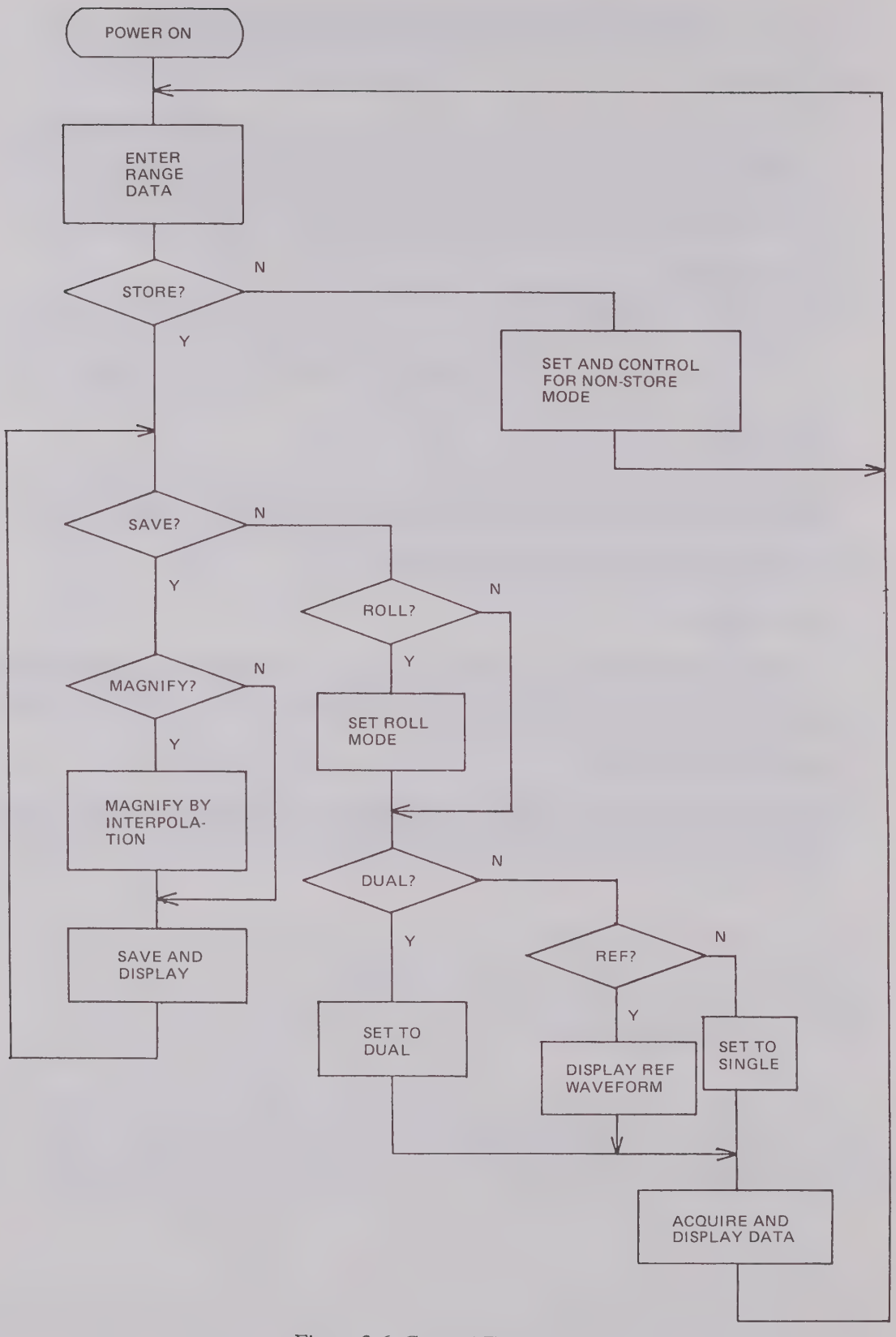


Figure 3-6 General Flowchart

○ Crystal oscillator:

The crystal oscillator (XTL801) generates an 8-MHz signal. This signal is frequency-divided by the counter (U827) into clock signals which are fed to the various circuits as shown in Table 3-1.

Table 3-1

U827 output	Frequency	Circuits served
Q_A, No. 14	4 MHz	Microprocessor, DMA, CTC1, CTC2
Q_B, No. 14	2 MHz	CTC1, CTC2
Q_D, No. 11	500 kHz	Store-mode sweep circuit

3.5.3 I/O Map

I/O port mapping is such that a device set by address 2 – 5 is selected by the demultiplexer which operates an $\overline{IORQ}$ and $\overline{M1}$ received from the CPU. I/O mapping is shown in Figure 3-7.

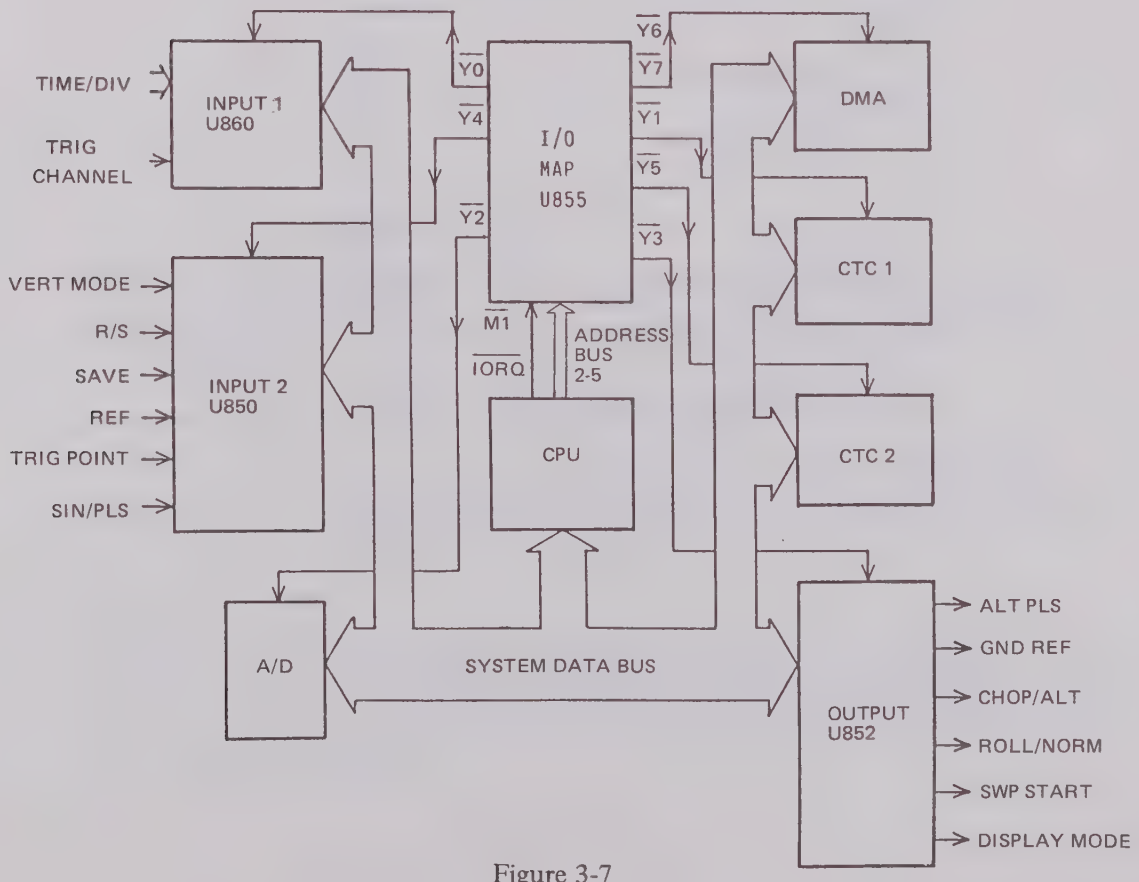


Figure 3-7

3.5.4 Reading of Panel Data & Setting of Operation Mode

When in the store mode, the CPU reads panel data through the input ports as required and sets the operation mode through output port.

- Input port 1 (U860):

Terminals 1 – 6 (pins 2 – 7) of input port 1 receive the TIME/DIV range data which has been coded by the time base control circuit and terminals 7 and 8 (pins 8 and 9) receive the data of the channels which are triggered when in the DUAL VERT mode. The chip-selected data is sent out onto the data bus.

- Input port 2 (U850):

Input port 2 (U850) accepts data and delivers them onto the data bus as shown in Table 3-2.

Table 3-2

Bit 1, bit 2 VERT mode	Bit 1	Bit 2	Mode
	L	L	ADD
	L	H	CH2
	H	L	CH1
	H	H	DUAL
Bit 3 STORE/NON STORE	H		NON-STORE
	L		STORE
Bit 4, bit 8 PRE-DELAY position	Bit 4	Bit 8	Position
	L	H	8 div
	H	L	5 div
	H	H	2 div
Bit 5 SINE/PULSE	H		PAUSE
	L		SINE
Bit 6 SAVE	H		NORMAL
	L		SAVE
Bit 7 REFERENCE	H		OFF
	L		ON

○ Output Port (U852)

The mode-setting output port (U852) is used to set the various circuits by the CPU in conformity with data received through input ports 1 and 2. The functions of the bits are shown in Table 3-3.

Table 3-3

Bit 1 SALTPLS	Alternate pulse output for channel selection when in store mode		
Bit 2 GNDREF	L H		Signal acquisition Signal port
Bit 3, bit 4 Select signal for channel select pulse	Bit 3 L L H H	Bit 4 L H L H	 NON-STORE ALT STORE CHOP STORE ALT NON-STORE CHOP
Bit 5 ROLL	L H		ROLL mode NORM mode
Bit 6 ST SWP CONT	L H		STOP SWEEP
Bit 7, bit 8	Bit 7 0 1	Bit 8 1 1	 Single channel Dual, or single channel + REF

3.5.5 Store Signal Pickoff A/D Converter Circuit

The store signal pickoff and A/D converter circuit converts the analog current signal which is fed through the channel selector into a voltage signal and converts it into an 8-bit digital signal.

○ Store signal pickoff circuit (Q806, 807/Q808/Q810/U806):

The current signal fed through the channel selector circuit is converted into a voltage signal by U806 (1/2), Q806 and Q807, and amplified by Q808 and Q810 to a level sufficiently high for processing by the A/D converter.

○ A/D converter circuit:

For this circuit a reference voltage is provided by U801. When the ADRD signal (which is the result of an AND logic operation between RD of CPU and Y2 of output port) is fed from the A/D controller, the two A/D converters alternately send out 8-bit data onto the system data bus. See Figure 3-8.

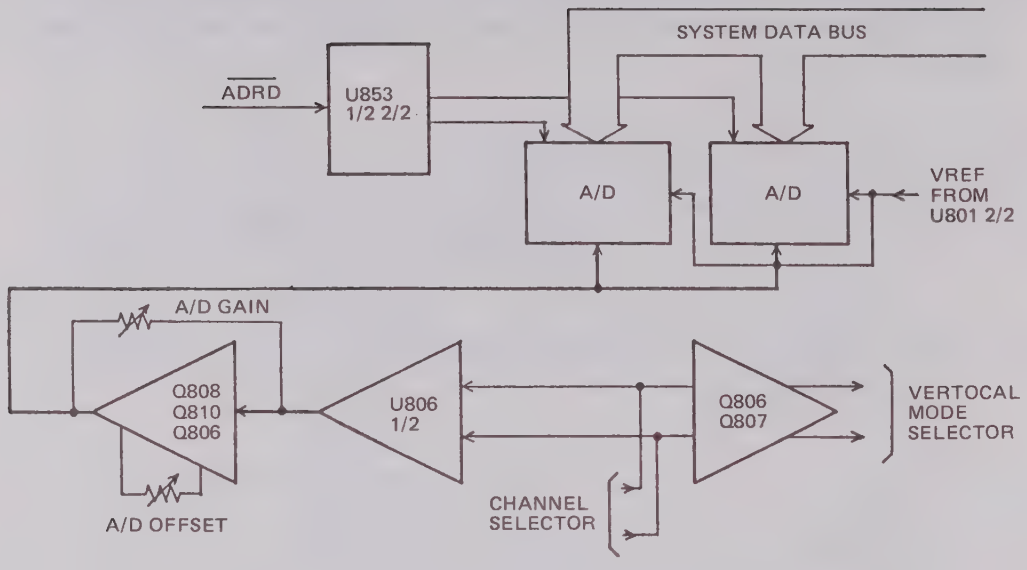


Figure 3-8

3.5.6 Acquisition Logic Trigger Circuit

This circuit controls the timing of data acquisition by selecting trigger pulse received from the trigger generator in conformity with CPU operation.

- Acquisition logic circuit:

  This circuit controls data acquisition operation and its ending operation.

  Acquisition gate U825 (4/4) opens gate U815 (4/4) as $\overline{\text{BUSAK}}$ is received from the CPU (output port U852, bit 5, when in the ROLL mode), the gate passes the pulse which is obtained by frequency-dividing the system clock to twice of the sampling clock by CTC2-0 and CTC2-1, and the hold-off counters (CTC1-2, CTC2-2) generate a hold-off pulse.

  Later, as the $\overline{\text{ST TRIG}}$ pulse is applied to U815 (1/4), the pulse signals are applied to counters CTC1-0 and CTC1-1 in order to count the number of data acquisition cycles by A/D and DMA transfer. When counting (which depends on the trigger point) is over, calculation is made for the corresponding mode, data is transferred to the display memory and at the same time an acquisition end pulse is delivered to $\overline{\text{Q}}$ of U863 (2/2) to clear the trigger circuit.

  The above operation is illustration in Figure 3-9.

  Note: When in the ROLL mode, data is acquired constantly.

○ Trigger circuit:

The trigger circuit is comprised of two flip-flops with preset/clear function (one for the trigger gate enable circuit U865 (1/2) and the other for the trigger gate) and a jitter cancel circuit.

The following signals are fed to the trigger gate enable circuit U865 (1/2) from the acquisition logic circuit.

CLOCK terminal (pin 1) ← Hold-off pulse
PRESET terminal (pin 4) ← $\overline{R/S}$
CLEAR terminal (pin 15) ← Acquisition end pulse

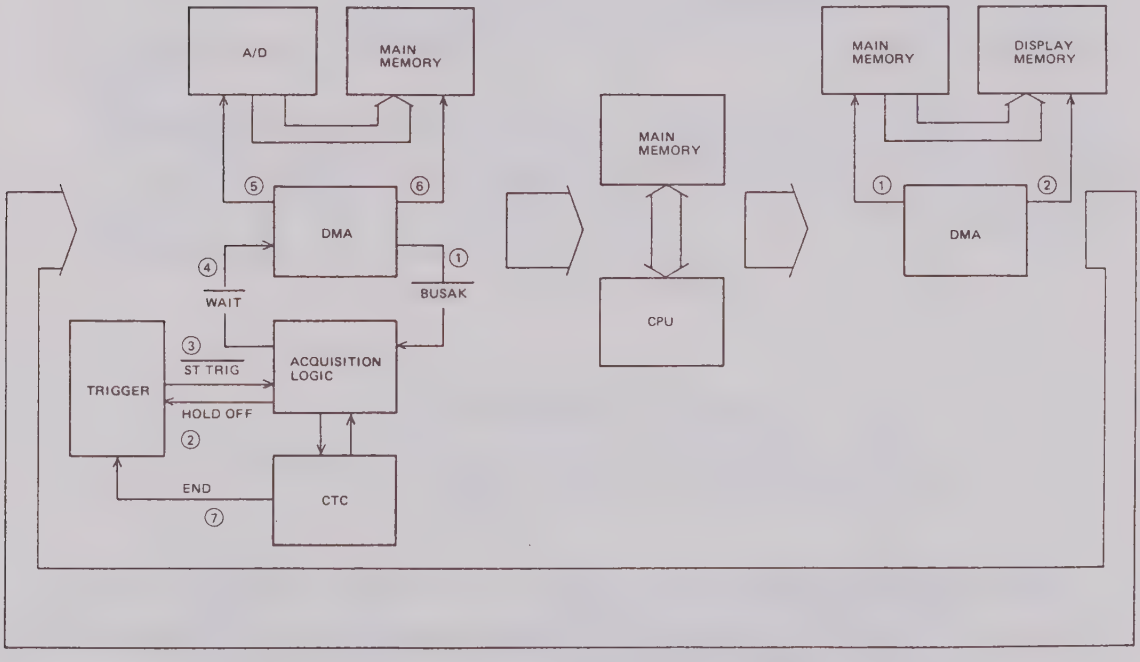


Figure 3-9 Acquisition Cycle

As the hold-off pulse is received, terminal Q (pin 5) sends a trigger enable signal to the trigger gate. Upon receipt of this signal, the trigger gate delivers an $\overline{\text{ST TRIG}}$ pulse to the acquisition logic via terminal Q (pin 7). Later, as an acquisition end pulse is fed from the acquisition logic, the above circuits are reset.

The above operation is illustrated in Figure 3-10.

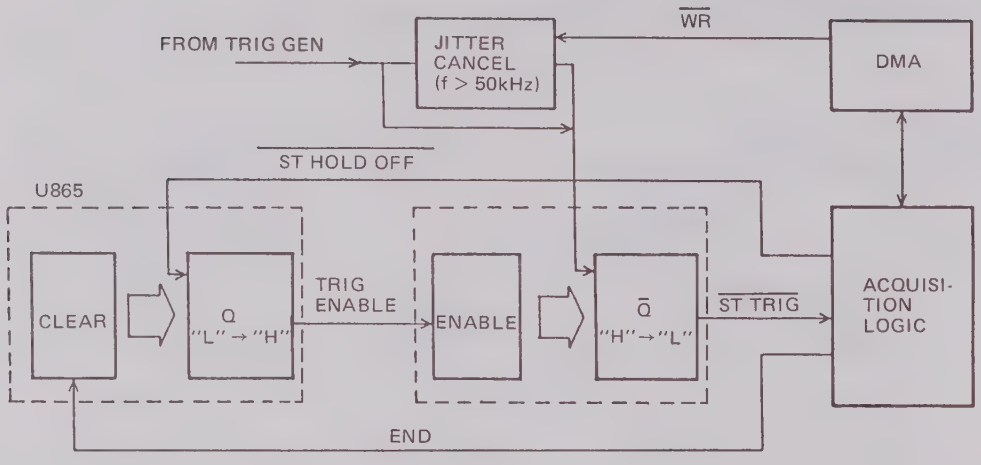


Figure 3-10. Trigger circuit

Note: Even when no trigger pulse is appearing at the CLOCK terminal, if the equipment is in the AUTO mode, the $\overline{\text{ST TRIG}}$ pulse is generated by the AUTO signal as in the case of the NON-STORE mode.

○ Jitter cancel circuit:

The jitter cancel circuit is enabled by the frequency comparator U816 (3/16) when the trigger pulse frequency has become higher than approximately 50 kHz. At the same time, a NAND logic is exercised between the above signal and the signal which is obtained by converting by U814 (3/4) and U816 (5/6) the $\overline{\text{WR}}$ signal received from the CPU, the resultant jitterless pulse is fed to the trigger gate circuit, and only the trigger pulse which falls within the jitterless pulse is handled as an effective trigger pulse.

3.5.7 Display Memory

The display memory is comprised of a memory unit for storing signal waveform data and an address counter which sequentially sends data to the D/A converter.

- Display memory:

Data to the display memory is transferred from the main unit by selecting the main memory or the display memory with U856 ($\overline{Y0}$, $\overline{Y2}$), changing the address bus switch (U820 - 2) over the system address bus, and through the bi-directional buffer with the DMA.

Data is constantly delivered from the display memory to the D/A converter except when data is entered from the main memory. In this case, the address bus switch is changed over to the display address bus and the contents of the address set by the display address counter (U810-2) are delivered to the D/A converter. The display address counter is connected to the output port U852 (pin 15) for synchronization of the store mode sweep generator.

When in the REFERENCE or ROLL mode, data may be transferred and accessed from the display memory to the main memory in the reverse direction. In this case, the address bus switch is changed over to the system address bus and data is transferred to the main memory through the bi-directional buffer. See Figure 3-11.

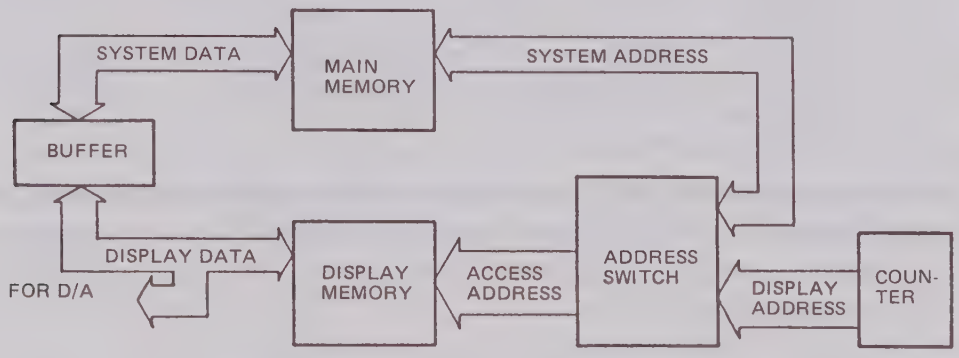


Figure 3-11

3.5.8 D/A Converter Circuit

The D/A converter circuit converts the 8-bit signal wvaeform data received from the display memory into an analog signal with the D/A converter and delivers the analog signal through the differential amplifier to the vertical mode selector. See Figure 3-12.

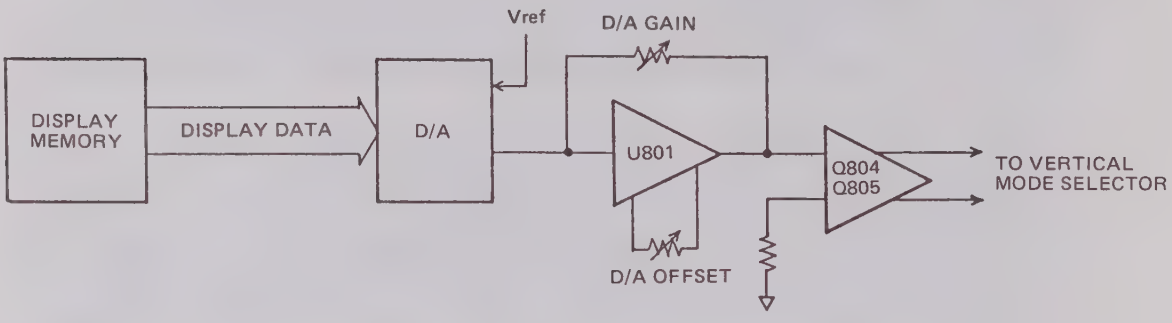


Figure 3-12

3.5.9 Store Mode Sweep Generator

The store mode sweep generator operates being controlled to synchronize with the D/A converter output.

- Store mode sweep control logic:

  The store mode sweep control logic dictates the start of sweep by driving to the "L" state the output of gate U826 (1/4) with the output port U852 (pin 15). Later, as the signal to notify the end of counting for one sweep cycle of signal waveform is fed from U812 (pin 12) of the display address counter to the CLOCK terminal (pin 1), sweep is withheld for approximately 1.5 msec and the clock of the display address counter also stops.

- Store mode sweep generator:

  The store mode sweep generator produces a sawtooth wave being dictated by the control pulse received from the store mode sweep control logic. The sweep time constant depends on the constant-current circuit (Q802, U801-1/2). The sweep start level is controlled by U802-2/2. See Figure 3-13.

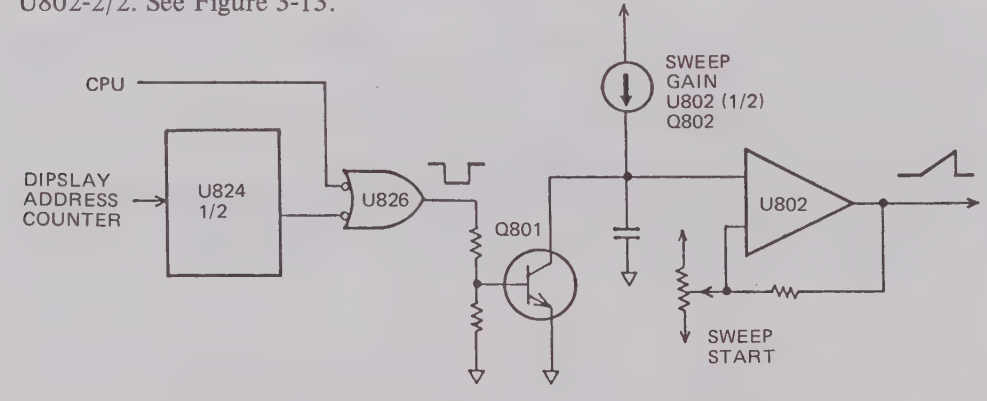


Figure 3-13

3.5.10 Other Circuit

- Blanking and channel switching pulse selector:

  This circuit, with the output port (U852, bits 3 and 4) of the microprocessor, controls the demultiplexer (U851), selects the CHOP or ALTERNATE pulse signal, and delivers a blanking signal and a channel switching signal.

  When in the store mode, the blanking signal is maintained in synchronization with the display memory circuit signal by U823 (2/4), U866 (1/2), and Q809.

- Store interval circuit:

  When the store interval function is turned on with S408, this circuit provides a time constant with RV408, R855 and C859, and delivers a $\overline{\text{WAIT}}$ signal by U866 (2/2) to the microprocesosr in order to control the acquisition intervals.

- Single sweep and auto slave circuit:

  When triggering is effected in the single sweep mode and data acquisition and display have become ready, the $\overline{\text{AUTO SAVE}}$ pulse is entered by U856 (pin 12) and the save data is delivered to input port 1 (U855) by U862 (1/4, 2/4) and U864 (1/4, 2/4).

3.6 POWER SUPPLY CIRCUIT

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required by means of the line voltage selector plug (P-47). Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and three windings of different voltages for different circuits of the CRT. The AC voltages of the three windings are rectifies and supplied as non-regulated +16 V power and regulated +160 V, +12 V, +5 V, and −12 V powers.

3.7 CALIBRATOR CIRCUIT

The calibrator circuit provides square-wave calibration voltage signal of 2 Vp-p which is used for calibration of the probe and amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signal is produced by generating a signal with the multivibrator of CMOS IC (U1601 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1601 3/4, 4/4), and dividing the voltage signal with resistors.

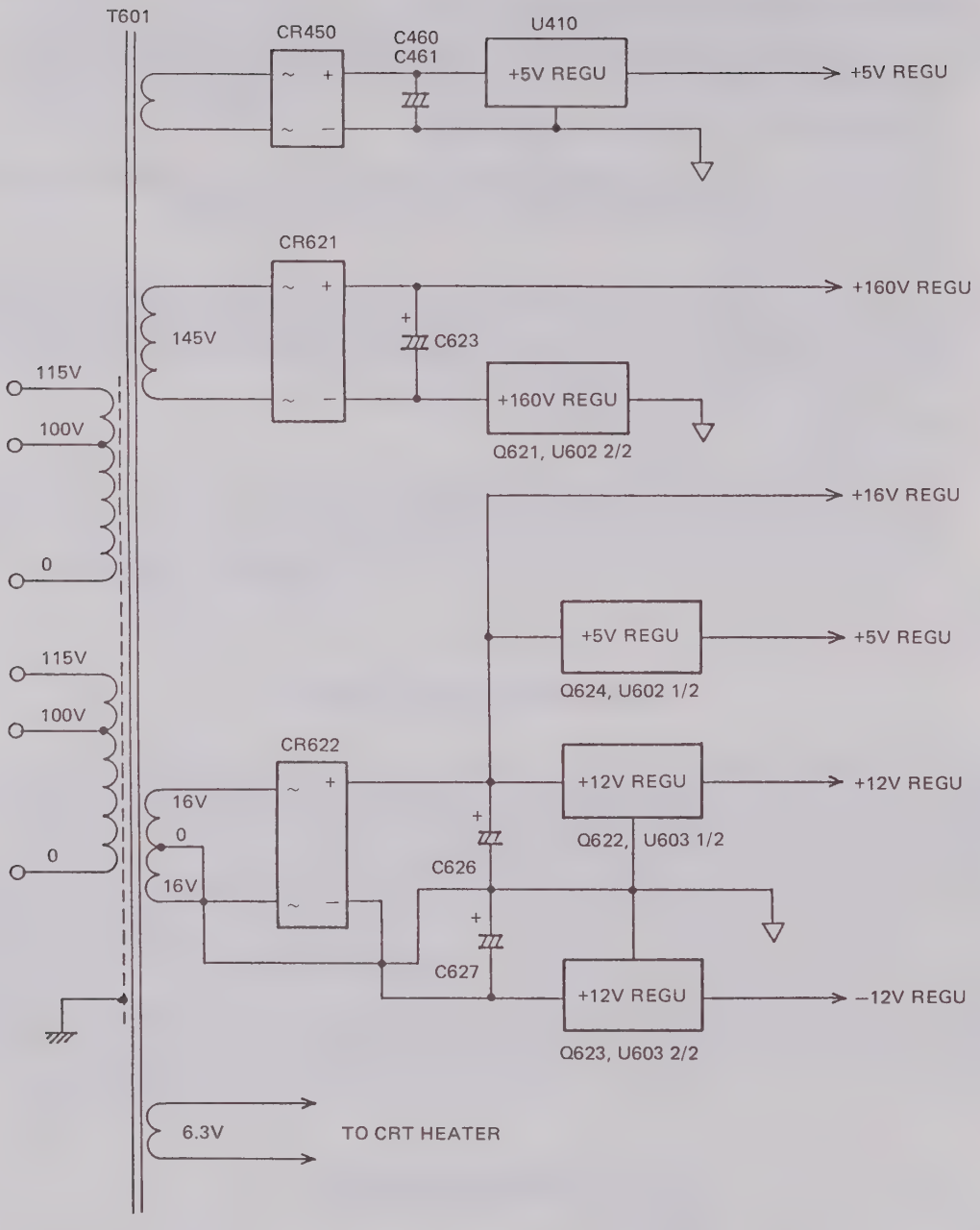

T601
CR450
C460
C461
U410
+5V REGU
+5V REGU
CR621
+160V REGU
145V
C623
115V
100V
+160V REGU
Q621, U602 2/2
0
+16V REGU
+5V REGU
+5V REGU
Q624, U602 1/2
115V
100V
CR622
+12V REGU
+12V REGU
16V
0
16V
Q622, U603 1/2
0
C626
C627
+12V REGU
–12V REGU
Q623, U603 2/2
6.3V
TO CRT HEATER

Figure 3-14

4. MAINTENANCE

4.1 PREVENTIVE MAINTENANCE

The major preventive maintenance items are cleaning and visual inspection of the instrument. It is highly recommendable to render preventive maintenance service periodically on an established time schedule.

4.1.1 Removing the Case

To remove the case, remove the five screws shown in Figure 4-1 and pull out the instrument chassis.

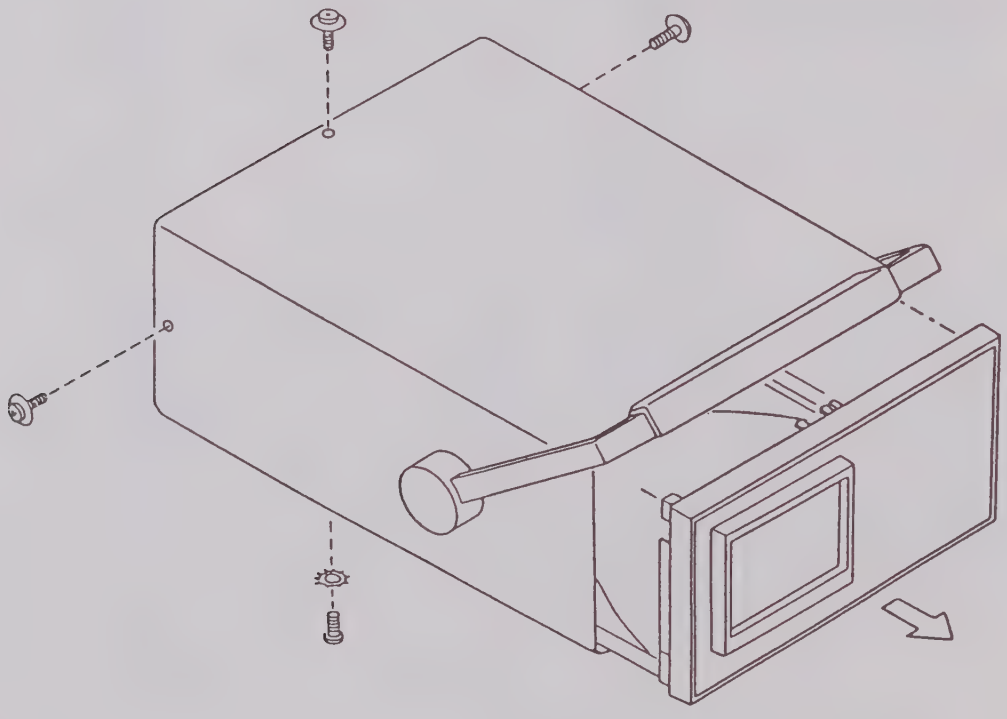


Figure 4-1

4.1.2 Cleaning the Instrument

Blow away dust collected in the instrument by using a clean compressed air. Clean especially carefully the insulators of the high voltage circuit in order to prevent insulation degradation. Also clean carefully the heat sinks to prevent heat radiation degradation.

CAUTION

Do not wash the instrument with water or detergent. To remove adherent dirt from inside or outside of the instrument, use of chlorophlorocarbon (Freon) is recommended. Never used benzene, thinner, toluene or other volatile or highly active chemicals to clean either inside or outside of the instrument.

4.1.3 Check of Semiconductors

It is not recommendable to attempt to check directly the transistors and other semiconductors of the instrument for periodical maintenance service. It is most recommendable to find out whether such circuit elements are operating normally or not through proper manipulation of the instrument. If the instrument does not operate normally when it is manipulated properly, render appropriate service referring to the paragraphs of calibration or troubleshooting given in this manual.

4.2 PERFORMANCE CHECK

4.2.1 General

Action check of function with the instrument is noted here. Every item is comprised of various checking points. And if there is any irregular action found in any item, it means malfunction or trouble, do necessary steps for readjustment or repair according to the item of calibration.

Initial setting of various function check for every kinds of our instrument is shown below as table 4-1.

	Function	Setting	Remarks
Power	POWER	ON	
CRT group	INTEN	Ample brightness	Position between 2 ~ 3 o'clock points
	FOCUS	Setting for best focus point	
	ILLUM	Maximum counterclockwise rotation	
Vertical axis group	Vertical sensitivity	5 mV/DIV	For both of CH1, CH2
	VARIABLE	CAL'D	For both of CH1, CH2
	PULL x5MAG	OFF	For both of CH1, CH2
	Input coupling	DC	For both of CH1, CH2
	POSITION	At the center point	For both of CH1, CH2
	VERT MODE	CH1	
	CH2 INV	OFF	
Trigger group	INT TRIG	VERT MODE	
	SOURCE	INT	
	COUPLING	AC	
	SLOPE	+	
	LEVEL	LOCK (Maximum counter-clockwise rotation)	
	SWEEP MODE	AUTO	
Horizontal axis group	TIME/DIV	1 ms	
	VARIABLE	CAL'D	
	PULL x10MAG	OFF	
	H POSITION	At the center point	
	HOLDOFF	Maximum counterclockwise rotation	
Storage group	STORAGE/REAL	REAL	
	SINE/PULSE	PULSE	
	SAVE	OFF	
	REF	OFF	
	PEN	OFF	

Table 4-1 Initial Setting

4.2.2 Vertical System Check

(1) STEP balance checl

1) Initialize the instrument according to Table 4.1.

2) Set the CH1 input coupling to GND, and confirm that the base line on CRT screen is shifted within the range of ±0.2 DIV when the vertical sensitivity is switched as follows: 5 mV/DIV → 10 mV/DIV → 20 mV/DIV → 50 mV/DIV.

3) Set VERT MODE to CH2.

4) Confirm that the base line for CH2 is also shifted within the range of ±0.2 DIV when the vertical sensitivity is switched in the same way as that for CH1.

(2) x5MAG balance check

1) Initialize the instrument according to Table 4.1.

2) Set the CH1 input coupling to GND, and pull and push the VARIABLE button for CH1 to turn on and off the x5MAG function for CH1. Confirm that the base line on CRT screen is shifted within the range of ±1.0 DIV when the x5MAG function is switched from ON to OFF and vice versa.

3) Set VERT MODE to CH2.

4) Confirm that the base line for CH2 is also shifted within the range of ±1.0 DIV when the x5MAG function for CH2 is turned on and off.

(3) DC balance check

1) Initialize the instrument according to Table 4.1.

2) Set the CH1 input coupling to GND, and turn VARIABLE for CH1 from the right maximum to left maximum. Confirm that the base line on CRT screen is shifted within the range of ±0.5 DIV when the VARIABLE is turned.

3) Set VERT MODE to CH2.

4) Confirm that the base line for CH2 is also shifted within the range of ±0.5 DIV when the VARIABLE for CH2 is turned in the same way as above.

(4) ADD balance check

1) Initialize the instrument according to Table 4.1.

2) Set VERT MODE to the dual channel mode (press both CH1 and CH2 buttons).

3) Set the base lines for CH1 and CH2 exactly at the center of the CRT screen (place one base line on the other).

4) Set VERT MODE to ADD, and see if the base line is shifted only within the range of ±0.5 DIV.

(5) CH2 INV balance check

1) Initialize the instrument according to Table 4.1.

2) Set VERT MODE to CH2 and CH2 input coupling to GND.

3) Place the base line at the center of the CRT screen by POSITION (CH2).

4) Turn on and off the INV function for CH2, and see if the base line is shifted only within the range of ±1 DIV.

(6) Vertical position check

1) Initialize the instrument according to Table 4.1

2) Set the CH1 input coupling to GND, and turn POSITION (CH1) from right maximum to left maximum.
Confirm that the base line moves on the entire screen when the POSITION is turned.

3) Set VERT MODE to CH2.

4) Confirm that the base line for CH2 also moves on the entire screen.

(7) Vertical sensitivity check (see Table 4.2)

1) Initialize the instrument according to Table 4.1.

2) Input an amplitude calibration signal from a vertical axis calibrator to CH1, and confirm that the sensitivity error for each range is within ±3% (±5% when the x5MAG function is on).

3) Set VERT MODE to CH2.

4) Confirm that the sensitivity error for each range for CH2 is also within ±3% (±5% when the x5MAG function is on).

Table 4.2 Vertical Sensitivity Error Ranges

Vertical axis	x5MAG	Oscilloscope range	Vertical axis calibrator range	Oscilloscope CRT screen amplitude	Sensitivity error range
CH1 & CH2	OFF	5 mV/DIV	20 mV	4 DIV	±0.12 DIV
		10 mV/DIV	50 mV	5 DIV	±0.15 DIV
		20 mV/DIV	0.1 V	5 DIV	±0.15 DIV
		50 mV/DIV	0.2 V	4 DIV	±0.12 DIV
		0.1 V/DIV	0.5 V	5 DIV	±0.15 DIV
		0.2 V/DIV	1 V	5 DIV	±0.15 DIV
		0.5 V/DIV	2 V	4 DIV	±0.12 DIV
		1 V/DIV	5 V	5 DIV	±0.15 DIV
		2 V/DIV	10 V	5 DIV	±0.15 DIV
		5 V/DIV	20 V	4 DIV	±0.12 DIV
	ON	1 mV/DIV	5 mV	5 DIV	±0.25 DIV

(8) Vertical VARIABLE check

1) Initialize the instrument according to Table 4.1.
2) Input an amplitude calibration signal of 20 mVp-p from a vertical axis calibrator to CH1. (The amplitude on CRT screen is 4 DIV.)
3) Turn the CH1 VARIABLE to the left maximum, and confirm that the amplitude on CRT screen is 1.6 DIV or less.
4) Set VERT MODE to CH2 to input the above signal to CH2.
5) Confirm that the amplitude on CRT screen is also 1.6 DIV or less when the CH2 VARIABLE is turned to the left maximum.

(9) Vertical low frequency characteristic check

1) Initialize the instrument according to Table 4.1.
2) Set the CH1 sensitivity to 10 mV/DIV.
3) Input a square waveform signal of approximately 1 kHz from a vertical axis calibrator to CH1, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 6 DIV.
4) Confirm that the flatness characteristic of the observed square waveform is 3% or less.
5) Set VERT MODE to CH2.
6) Set the CH2 sensitivity to 10 mV/DIV, and input the above signal to CH2.
7) Confirm that the flatness characteristic of the observed square waveform for CH2 is also 3% or less.

(10) Input attenuator (ATT) frequency characteristic check

1) Initialize the instrument according to Table 4.1.
2) Input a square waveform signal of approximate 1 kHz from a vertical axis calibrator to CH1, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 5 DIV.
3) Confirm that the flatness characteristic of the observed square waveform is 3% or less.
4) Confirm that the flatness characteristic of the observed square waveform is 3% or less at each range.
5) Set VERT MODE to CH2.
6) Confirm that the flatness characteristic of the observed square waveform for CH2 is also 3% or less at each range.

(11) Vertical high frequency characteristic check

1) Initialize the instrument according to Table 4.1.
2) Set the CH1 sensitivity to 10 mV/DIV.
3) Set TIME/DIV to 0.2 μs/DIV.
4) Input a square waveform signal of approximately 1 MHz from a vertical axis calibrator to CH1, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 5 DIV.
5) Confirm that the flatness characteristic of the observed square waveform is 5% or less.
6) Set VERT MODE to CH2, and the CH2 sensitivity to 10 mV/DIV.
7) Input the above signal to CH2, and confirm that the flatness characteristic of the observed square waveform for CH2 is also 5% or less.

4.2.3 Trigger System

(1) TRIG SOURCE check

1) Initialize the instrument according to Table 4.1.
2) Set TIME/DIV to 10 μs/DIV.
3) Input a signal of 50 kHz from a signal generator to CH1, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 4 DIV.
4) Confirm that the waveform on CRT screen looks still without jitter.
5) Switch VERT MODE to CH2, and input the above signal to CH2.
6) Confirm that the waveform on CRT screen also looks still without jitter for CH2.
7) Switch TRIG SOURCE to LINE.
8) Set TIME/DIV to 5 ms/DIV.
9) Input the LINE signal to CH1 or CH2.
10) Confirm that the waveform on CRT screen looks still without jitter.
11) Switch TRIG SOURCE to EXT.
12) Input a signal of 50 kHz from a signal generator to CH1 and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 4 DIV, as done in step 3).
13) Set TIME/DIV to 10 μs/DIV.
14) Apply the signal from "CH1 SIGNAL OUT" on rear panel to EXT input terminal.
15) Confirm that the waveform on CRT screen looks still without jitter, as done in step 4).

(2) TRIG COUPLING check

1) Initialize the instrument according to Table 4.1

2) Input an amplitude calibration signal from a vertical axis calibrator to CH1, and adjust the signal so that the amplitude of the waveform observed on CRT screen becomes 2 DIV.

3) Release TRIG LEVEL from LEVEL LOCK, and turn the TRIG LEVEL dial till the waveform of the signal input to CH1 looks still without jitter on CRT screen. (The trigger level should be set at the middle of the waveform amplitude.)

4) Change the amplitude of the signal input to CH1 to 4 DIV, and confirm that the waveform on the CRT screen looks still because it is triggered correctly and that the trigger position has been shifted.

5) Switch TRIG COUPLING to DC.

6) Set the amplitude of the signal to 2 DIV.

7) Execute the same operation as step 3), and change the amplitude of the signal input to CH1 to 4 DIV. Then, confirm that the waveform on the CRT screen looks still because it is triggered correctly and that the trigger position has not been shifted.

8) Switch TRIG COUPLING to AC.

9) Input a signal of 1 MHz from a signal generator to CH1, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 4 DIV.

10) Set TIME/DIV to 1 μs/DIV.

11) Turn the TRIG LEVEL dial to give a trigger to the above signal.

12) Set TRIG COUPLING to HF REJ, and confirm that a trigger is not given to the above signal (because the trigger signal is attenuated).

13) Switch TRIG COUPLING to TV.

14) Apply a video signal of 4 DIV to the CH1 input terminal.

15) Set TRIG SLOPE to "–".

16) Confirm that the TV.V signal is observed when TIME/DIV is in the low speed range of 0.1 or more ms/DIV and that the TV.H signal is observed when TIME/DIV is in the high speed range of 50 or more s/DIV.

(3) TRIG SLOPE check

1) Initialize the instrument according to Table 4.1.

2) Input an amplitude calibration signal of 20 mVp-p from a vertical axis calibrator to CH1.

3) Release TRIG LEVEL from LEVEL LOCK, and turn the TRIG LEVEL dial till the waveform of the signal input to CH1 looks still without jitter on CRT screen. (The trigger level should be set at the middle of the waveform amplitude.)

4) Confirm that the waveform on the CRT screen is triggered correctly at the plus (+) slope.

5) Set TRIG SLOPE to "–".

6) Confirm that the waveform on the CRT screen is triggered correctly at the minus (–) slope.

(4) SWEEP MODE check

1) Initialize the instrument according to Table 4.1.

2) Input a signal of 50 kHz to CH1 from a signal generator, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 4 DIV.

3) Set TIME/DIV to 10 μs/DIV.

4) Release TRIG LEVEL from LEVEL LOCK, and turn the TRIG LEVEL dial slowly clockwise. Confirm that the waveform in FREE RUN state starts being triggered at the minus (–) peak and the trigger position moves to reach the plus (+) peak as the dial is turned. Also confirm that the waveform returns to the FREE RUN state when the dial is turned further.

5) Set the CH1 input coupling to GND, and confirm that the signal waveform disappears from the screen, leaving only one base line.

6) Set SWEEP MODE to NORM, and turn the TRIG LEVEL dial counterclockwise up to the maximum (immediately before LEVEL LOCK).

7) Turn the TRIG LEVEL dial clockwise, and confirm that a waveform appears on the CRT screen and starts being triggered at the minus (–) peak. Also confirm that the trigger position moves to reach the plus (+) peak and the waveform disappears from the screen when the dial is turned further.

8) Set the CH1 input coupling to GND when the signal is triggered, and confirm that the base line and waveform disappear from the screen.

9) Switch the CH1 input coupling back to DC, and trigger the signal by turning the TRIG LEVEL dial.

10) Set SWEEP MODE to SINGLE.

11) Set TIME/DIV to 1 s/DIV.

12) Set the CH1 input coupling to GND, and press SINGLE. (PUSH TO RESET).

13) Confirm that the LED at the upper right side of the SINGLE switch is turned on to indicate that the instrument has entered the single sweep wait mode.

14) Sset the CH1 input coupling back to DC.

15) Confirm that a signal is input and triggered and that a single sweep is observed.

4.2.4 Horizontal System

(1) Horizontal axis sensitivity check (for X-Y)

1) Initialize the instrument according to Table 4.1.
2) Set TIME/DIV to "X-Y or EXT HOR".
3) Set TRIG SOURCE to INT.
4) Set TRIG COUPLING to DC.
5) Set VERT MODE to CH2 (X-Y).
6) Set INT TRIG to CH1 (X-Y).
7) Apply an amplitude calibration signal of 1 Vp-p from a vertical axis calibrator to the EXT input terminal.
8) Confirm that the horizontal length of the waveform on the CRT screen is about 10 DIV ±20%.
9) Set TRIG SOURCE to CH1 (X-Y).
10) Set the CH1 input sensitivity to 10 mV/DIV.
11) Apply an amplitude calibration signal of 100 mVp-p from a vertical axis calibrator to the CH1 input terminal.
12) Confirm that the horizontal length of the waveform on CRT screen is 10.0 ±0.4 DIV.

(2) Horizontal position check

1) Initialize the instrument according to Table 4.1.
2) Apply the signal from a time mark generator set at 1 ms to the CH1 input terminal, and adjust the sensitivity of the oscilloscope till the amplitude of the waveform observed on CRT screen becomes 2 DIV.
3) Turn the horizontal position dial so that the sweep starts from the left edge of the CRT screen scale.
4) Switch TIME/DIV to "X-Y or EXT HOR", and confirm that a luminant mark is observed within ±1 DIV from the center of the CRT screen.

(3) Horizontal phase and frequency characteristics check (for X-Y)

1) Initialize the instrument according to Table 4.1.
2) Set TIME/DIV to "X-Y or EXT HOR".
3) Set TRIG SOURCE to EXT.
4) Set TRIG COUPLING to DC.
5) Set VERT MODE to CH2 (X-Y).
6) Set INT TRIG to CH1 (X-Y).
7) Set the CH1 input sensitivity to 0.1 V/DIV.

8) Apply a signal of 10 kHz and 0.8 Vp-p from a signal generator to the "EXT" and EXT input terminals.

9) Gradually increase the signal generator frequency, and confirm that the phase difference is within ±3° when the frequency is within 50 kHz.

10) Set TRIG SOURCE to INT (X-Y).

11) Set the CH1 input sensitivity to 0.1 V/DIV.

12) Apply a signal of 10 kHz and 0.8 Vp-p from a signal generator to the CH1 and CH2 input terminals.

13) As in step 9), gradually increase the signal generator frequency and confirm that the phase difference is within ±3° when the frequency is within 50 kHz.

14) Apply a signal of 50 kHz from the signal generator to only CH1, and adjust the signal till the amplitude on the CRT screen becomes 10 DIV.

15) Gradually increase the signal generator frequency, and confirm that the horizontal direction frequency characteristic is within −3 dB when the frequency is 2 MHz.

4.2.5 Time Base System

(1) SWEEP TIMING check

1) Initialize the instrument according to Table 4.1.

2) Apply a signal from a time mark generator to the CH1 input terminal, and switch the oscilloscope sensitivity till the amplitude of the waveform on CRT screen becomes approximately 2 DIV.

3) Switch TIME/DIV and the time mark generator oscillation ranges, and confirm that the error for each sweep range is within ±3%.

4) Pull the PULL x10MAG knob, and confirm that the sweep time error for each range is within ±5% (the sweep time error for the 0.5 μ/DIV range may be within ±8%).

(2) SWEEP VARIABLE check

1) Initialize the instrument according to Table 4.1.

2) Apply a signal from a time mark generator set at 10 ms to the CH1 input terminal, and adjust the oscilloscope input sensitivity till the amplitude of the waveform on the CRT screen becomes approximately 2 DIV.

3) Turn the SWEEP VARIABLE dial counterclockwise to the maximum position, and confirm that the sweep time at the maximum position is 2.5 times as long as that at the initial position.

4.2.6 Storage System

(1) STORAGE Check

1) Set the instrument for storage function according to table 4-1.

2) Set the "TIME/DIV" on "10 μs/DIV".

3) Connect the signal output of signal generator with CH1 input terminal with 50 kHz, and arrange the signal output as oscilloscope waveform on CRT display observed as 4 DIV.

4) Select "STORAGE/REAL" to "STORAGE".

5) Confirm the oscilloscope waveform on CRT is on Storage operation.

(2) SINE Interpolation Check

1) Set the instrument according to table 4-1.

2) Set "TIME/DIV" on "5 μs/DIV."

3) Connect the signal output of signal generator with CH1 input terminal with 250 kHz, and arrange the signal output as oscilloscope waveform on CRT display observed as 4 DIV.

4) Select "STORAGE/REAL" to "STORAGE".

5) Select "SINE/PULSE" to "SINE".

6) Confirm the oscilloscope waveform on CRT is on SINE interpolation.

(3) STORAGE SAVE Check

1) Set the instrument as per table 4-1.

2) Set "TIME/DIV" on "10 μs/DIV".

3) Connect the signal output of signal generator with CH1 input terminal with 50 kHz, and arrange the signal output as oscilloscope waveform on CRT display observed as 4 DIV.

4) Select "STORAGE/REAL" to "STORAGE".

5) Turn "SAVE" on.

6) Confirm oscilloscope waveform on CRT dipslay becomes standstill being SAVED.

(4) REFERENCE MEMORY Check

1) Set the instrument as per table 4-1.

2) Set "TIME/DIV" on "10 μs/DIV".

3) Connect the signal output of signal generator with CH1 input terminal with 50 kHz, and arrange the signal output as oscilloscope waveform on CRT display being observed as 4 DIV.

4) Select "STORAGE/REAL" to "STORAGE".

5) Turn "REF" on.

6) Confirm oscilloscope waveform on CRT display being observed standstill, with turning the vertical position of CH1.

4.3 CALIBRATION

4.3.1 General

It is needful to calibrate after a periodical use of the instrument. (Periodical Calibration)

Although it is used as inside parts of the instrument with minor changeable one, in case no calibration done for so long a time, there is some case when it could not satisfy the specifications of any part of the instrument by the accumulation of the changeability in a long time. Also, there is a case when found out either malfunction or trouble for which is out of use since the last periodical calibration.

Since it is a measurer, it works as one of a counter. And thus, the Data got by the instrument must be always read correct.

Also, in calibrating the instrument, be sure to make use of the calibrator with strictly modulated one. And together, take necessary care to the power source voltage applying to the calibrator in use.

The power voltage given in course of calibration of the instrument should be only within the range with tolerance of 100% ± 2% to the regular voltage of (100V, 115V, 215V and 230V), and with the frequency of 48 Hz ~ 62 Hz.

With the ambient temperature within the limit of 25°C ± 5°C and humidity as 60% ± 10%.

4.3.2 Table of Calibrating Gages

Tables shown as 4-4 and 4-5 for necessary measurement gage in use for the calibration.

Measurement gage		Faculty	Remarks
Digital voltage meter (1) (for low voltage use)		Within the limit range of 0 ~ 500V Accuracy within ±0.1%	Inner power voltage check
Digital voltage meter (2) (for high voltage use)		Within the limit range of 0 ~ 10 kV Accuracy within ±1%	Accelerating voltage check
Capacity meter		Within the limit range of 0 ~ 50 pF Accuracy within ±3%	Input capacity check
Vertical axis calibrator	Calibration of amplitude	Output voltage 1 mV ~ 50 Vp-p Output accuracy within ±0.3%	Calibration of vertical axis and X-Y amplitude Square waveform about 1 kHz
	Calibration of square waveform style	Output waveform square waveform Frequency 10 Hz ~ 1 MHz Rise time less than 1.0 ns Flatness within ±0.5%	Adjusting of square waveform flatness
Time mark generator		Mark output 5 s ~ 2 ns Output stability within ±0.1%	Calibration of time base
Signel generator		Frequency range 250 kHz ~ 100 MHz Frequency accuracy within ±1% Output voltage 5 mV ~ 5.5 Vp-p Output flatness within ±2%	Calibration of vertical axis with X-Y frequency Standard of 50 kHz
Wiring connection		Specification impedance 50Ω Length about 1m	More than 2 lines
Terminal parts		Specification impedance 50Ω Power more than 1/2W	2 pieces
Attenuator		Specification impedance 50Ω Power more than 1/2W	
Screwdriver Adjusting screwdriver		For 3 m/m use For low capacity use	

Table 4-5 Measurement gage for Calibration

4.3.3 Distribution of PCB

Table 4-6 shows the PCB be in use in the instrument. Also shows the inner position for all those of the PCB in Figure 4-2.

Specifications	Remarks
A1 VERT & P. SUPPLY	
A2 SWEEP & H.V	
A3 STORAGE MODE SW	
A4 CAL & CRT CONTROL	Below CRT
A5 PROCESSING UNIT	
A6 CRT CONNECTOR	With CRT socket
A7 VERT MODE SW	
A8 X-Y RECORDER OUT	
A9 EXCHANGE UNIT	With AC Line Exchanger

Table 4-6 A List of PCB

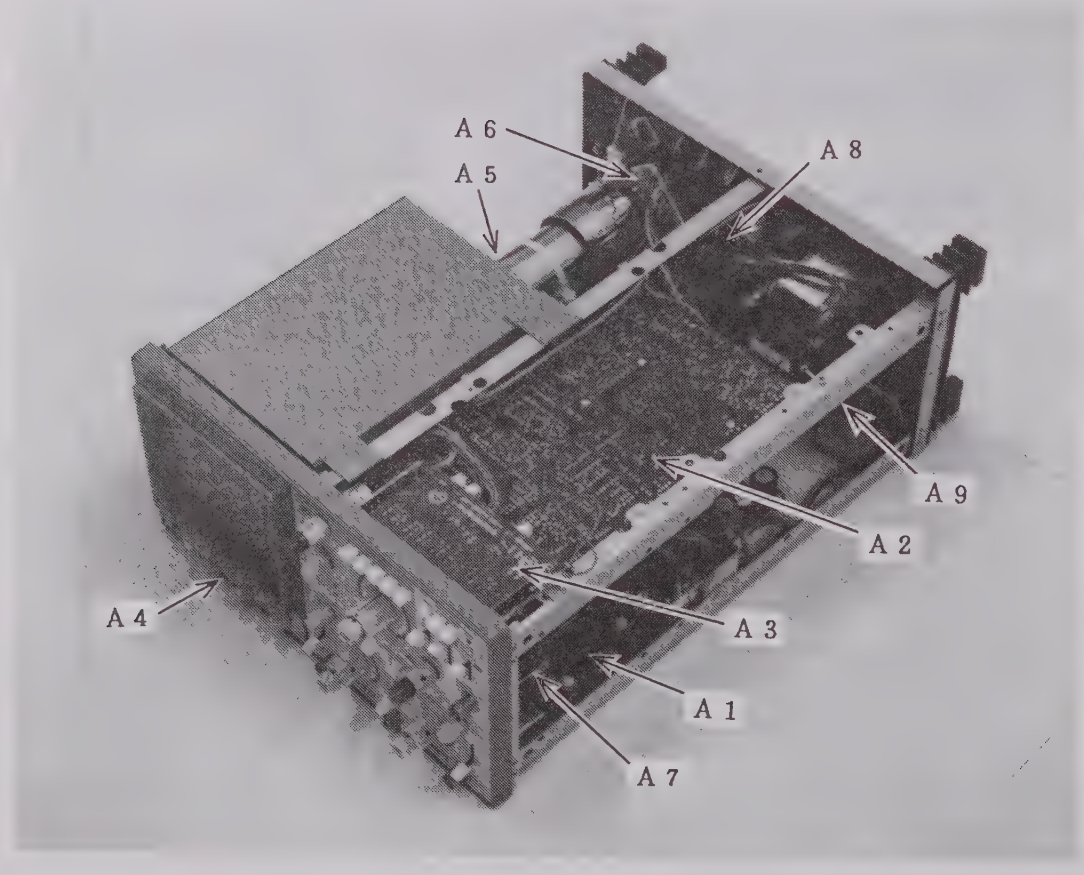


Fig. 4-2 PCB location

4.3.4 Calibration Procedure

The calibration must be processed skillfully in just the same good order as in the case of the instrument unit assembled.

The calibration must be performed as per the following process since the procedure being prepared for the shortest with the most regular success in order.

Although in case you want a partial performance instead of all those whole course you may start the calibration by the item you want, yet in this case, both two points must be surely completed as per the list, with 1) the adjusting and check of the inner power supply, and 2) adjustment of CRT system before your starting performance.

1) Initial setting

Settled table 4-7 as below for the initial setting of all those knobs and switches as for the common use on the panel face of the instrument of all various kinds ones.

	Function	Setting	Remarks
Power	POWER	ON	
CRT group	INTEN	Ample brightness	Position between 2 ~ 3 o'clock points
	FOCUS	Setting for best focus point	
	ILLUM	Maximum counterclockwise rotation	
Vertical axis group	Vertical sensitivity	10 mV/DIV	For both of CH1, CH2
	VARIABLE	CAL'D	For both of CH1, CH2
	PULL x5MAG	OFF	For both of CH1, CH2
	Input coupling	DC	For both of CH1, CH2
	POSITION	At the center point	For both of CH1, CH2
	VERT MODE	CH1	
	CH2 INV	OFF	
Trigger group	INT TRIG	VERT MODE	
	SOURCE	INT	
	COUPLING	AC	
	SLOPE	+	
	LEVEL	LOCK (Maximum counter-clockwise rotation)	
	SWEEP MODE	AUTO	
Horizontal axis group	TIME/DIV	1 ms	
	VARIABLE	CAL'D	
	PULL x10MAG	OFF	
	H POSITION	At the center point	
	HOLDOFF	Maximum counterclockwise rotation	
Storage group	STORAGE/REAL	REAL	
	SINE/PULSE	PULSE	
	SAVE	OFF	
	REF	OFF	
	PEN	OFF	

Table 4-7 Initial Setting for the common use items

2) Adjusting with check of the inner power source

As the power source of +12V built-in the instrument is the standard of all other power in connection with the unit, check the power source of +12V before starting every other points. And if the power source voltage of +12V is not within the range as per table 4-9, adjust +12V ADJ (RV606) on A1 PCB. And, with the other power voltage, there is no arranging except checking. Here shows all values of power source voltage on table 4-8 with both adjusting and checking points as in all those figures of 4-3, 4-4 and 4-5 as below.

DC Power Source	Voltage limit	Checking, adjusting points
+5V (for analog circuit use)	+4.6V ~ +5.6V	as per Fig. 4-3
+5V (for digital circuit use)	+4.5V ~ +5.5V	as per Fig. 4-4
+12V	+11.9V ~ +12.1V	RV606
−12V	−11.7V ~ +12.3V	as per Fig. 4-3
+160V	+148V ~ +168V	as per Fig. 4-3
−2100V	−1900V ~ −2300V	as per Fig. 4-5

Table 4-8 Power Source Voltage List

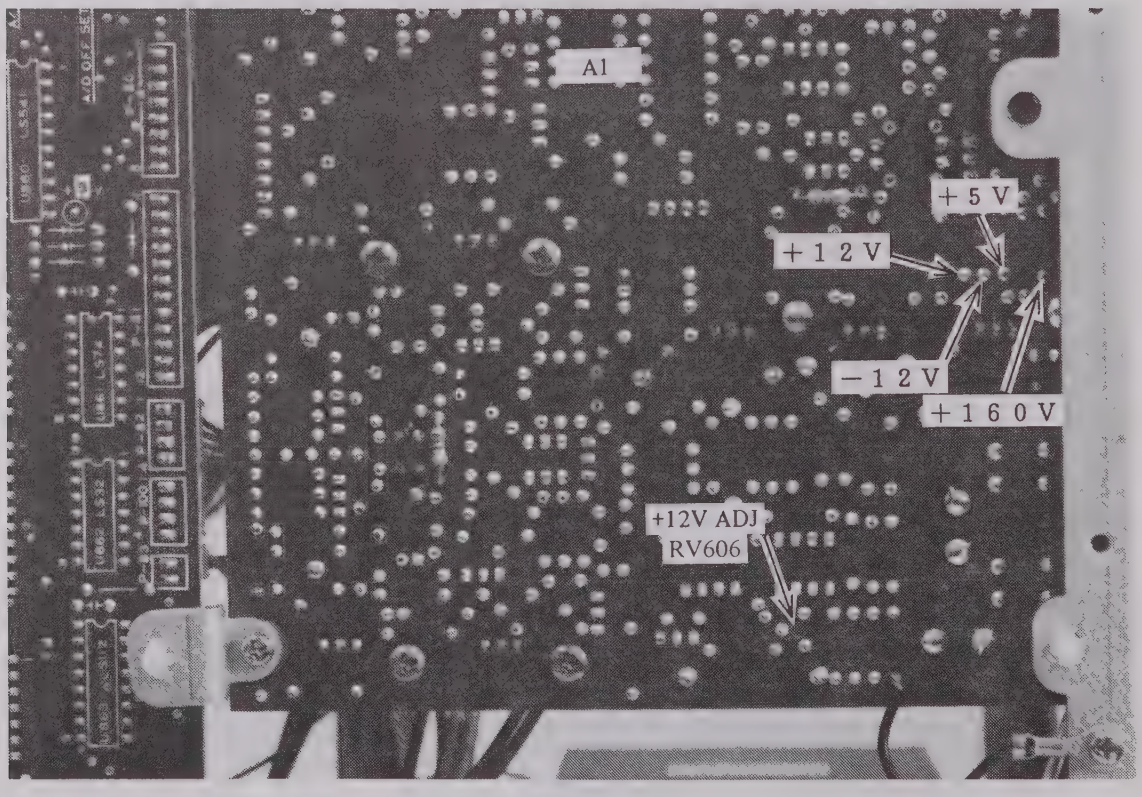


Fig. 4-3 Adjusting and Checking Points of Power Source Voltage

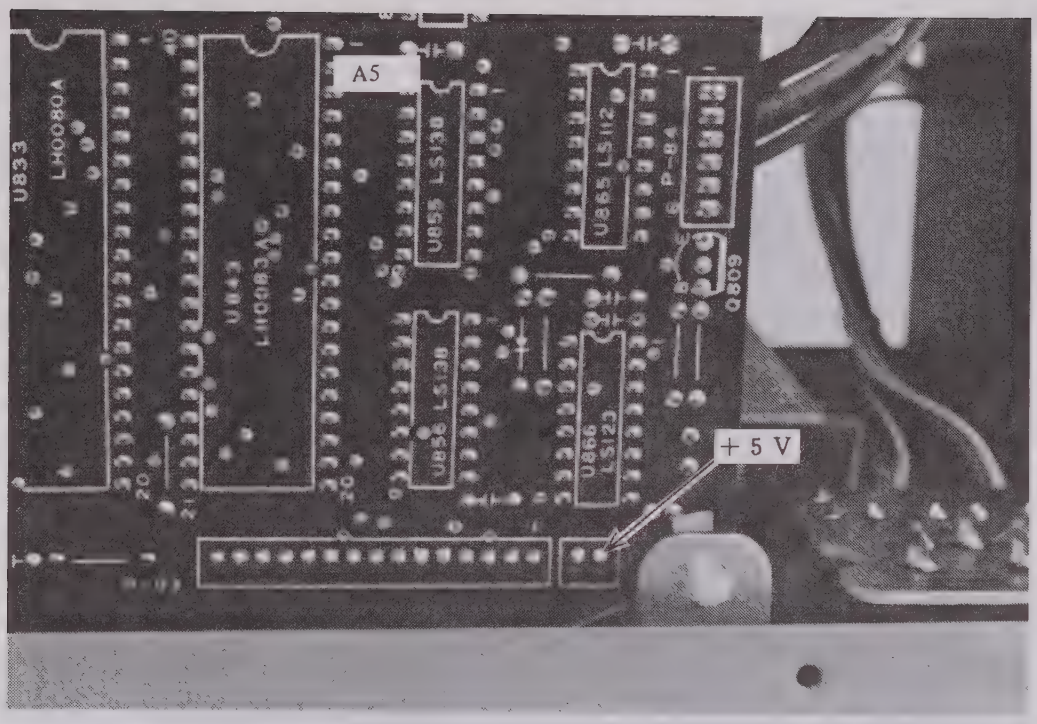


Fig. 4-4 +5V (for digital use) checking point

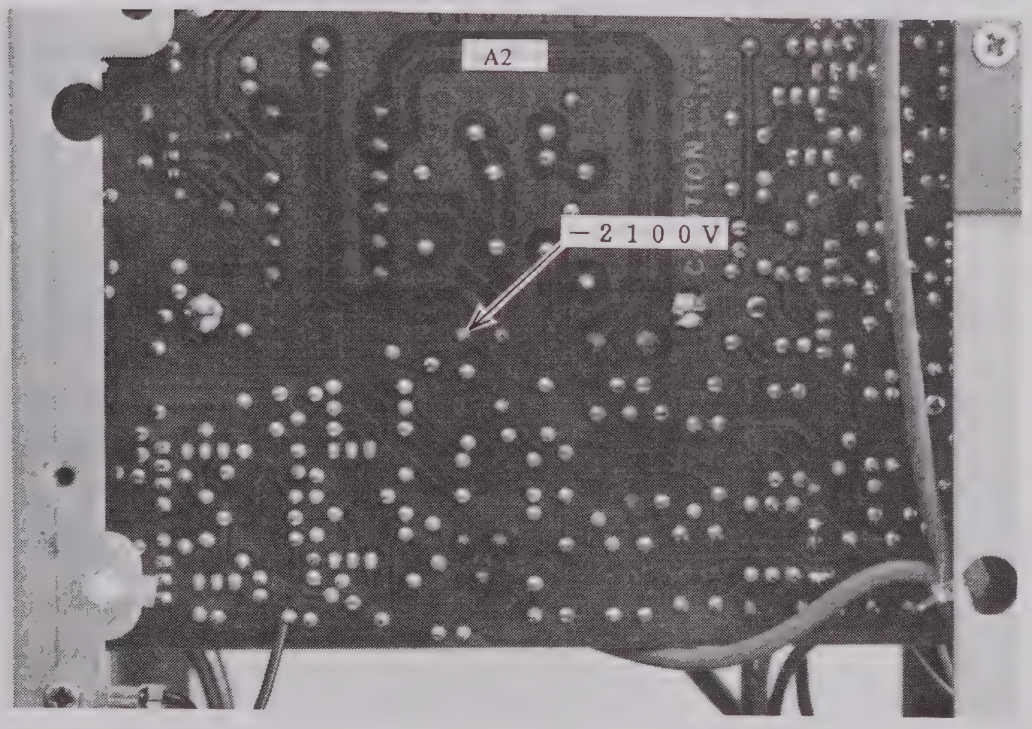


Fig. 4-5 −2100V checking point

(3) Adjustment of CRT circuits

CAUTION

The adjustment of CRT circuits affects the CRT deflection sensitivity as the adjustment of internal voltages does. So, after adjusting the CRT section, be sure to check the vertical sensitivity and sweep time.

(a) Adjustment of SUB INTEN

Adjust the INTEN position and brightness of base line.

1) Set TIME/DIV to 1 ms/DIV, and draw one horizontal base line on CRT screen.

2) Set the white dot of the INTEN dial to the position of 10 o'clock, and confirm that the base line can be seen faintly. If the base line looks too bright or cannot be seen at all, adjust the SUB INTEN control (RV653) on the A2 board shown in Fig. 4-6.

(b) Adjustment of SUB FOCUS

Adjust the FOCUS dial position.
Set the white dot of the FOCUS dial at the position of 12 o'clock and confirm that the best focus is obtained. If the best focus is not obtained when the white dot is at the position of 12 o'clock, adjust the SUB FOCUS control (RV651) on the A2 board shown in Fig. 4-6.

(c) Adjustment of ASTIG

Adjust the astigmatism of the electron lens in the CRT.

1) Set TIME/DIV to X-Y or EXT HOR, and display a beam spot in the center of the CRT screen with the horizontal and vertical POSITION controls.

2) Turn the FOCUS dial to an appropriate position, and see if the beam spot becomes a true circle. If the beam spot does not become a true circle by the turning of the FOCUS dial, adjust the ASTIG control (RV652) on the A2 board shown in Fig. 4-6.

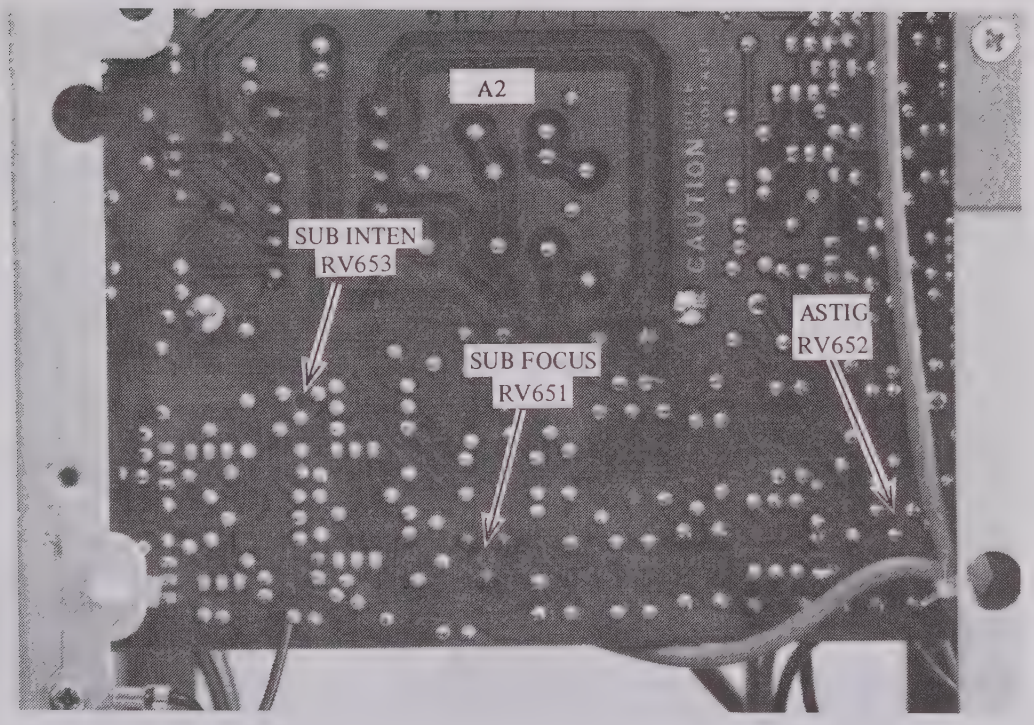


Fig. 4-6 Location of CRT Circuit Adjustment

(4) Adjustment of vertical axis

(a) STEP BAL

Use the STEP BAL control for minimizing the shift of trace when the vertical sensitivity is changed.

1) Initialize the oscilloscope according to Table 4-7.

2) Set the CH1 input coupling to GND, and confirm that the base line on CRT screen may be shifted only within the range of ±0.2 DIV when the vertical sensitivity is switched as follows:
10 mV → 20 mV → 50 mV/DIV
If the base line is shifted more than ±0.2 DIV, adjust the CH1 STEP BAL control (RV101) on the A1 board in Fig. 4-7.

3) Set VERT MODE to CH2, and CH2 input coupling to GND.

4) Confirm that the base line for CH2 is also shifted within the range of ±0.2 DIV when the vertical sensitivity is switched in the same way as that for CH1.
If the base line is shifted more than ±0.2 DIV, adjust the CH2 STEP BAL control (RV201) on the A1 board in Fig. 4-7.

(b) x5MAG balance

This control is for minimizing the shift of trace caused by the use of x5MAG function for vertical sensitivity.

1) Initialize the oscilloscope according to Table 4-7.

2) Set the CH1 input coupling to GND, and turn on and off the x5MAG (CH1) switch. Confirm that the trace (base line) may be shifted only within the range of ±1.0 DIV when the switch is set from ON to OFF and vice versa. If the trace on the CRT screen is shifted more than ±1.0 DIV, adjust the CH1 MAG DC BAL control (RV104) on the A1 board in Fig. 4-7.

3) Set VERT MODE to CH2, and CH2 input coupling to GND.

4) Confirm that the trace for CH2 may also be shifted within the range of ±1.0 DIV when the x5MAG (CH2) switch is turned on/off.
If the trace for CH2 is shifted more than ±1.0 DIV, adjust the CH2 MAG DC BAL control (RV204) on the A1 board in Fig. 4-7.

(c) DC balance

This control is for minimizing the shift of trace caused by the turning of the VARIABLE knob.

1) Initialize the oscilloscope according to Table 4-7.

2) Set the CH1 input coupling to GND. Turn the VARIABLE knob from the right maximum to the left maximum, and confirm that the trace on the CRT screen may be shifted within the range of ±0.5 DIV.
If the trace is shifted more than ±0.5 DIV, adjust the CH1 VAR DC BAL control (RV106) on the A1 board in Fig. 4-7.

3) Set VERT MODE to CH2, and CH2 input coupling to GND.

4) Confirm that the trace for CH2 may also be shifted within the range of ±0.5 DIV when the VARIABLE knob is turned in the same way as above.
If the trace is shifted more than ±0.5 DIV, adjust the CH2 VAR DC BAL control (RV206) on the A1 board in Fig. 4-7.

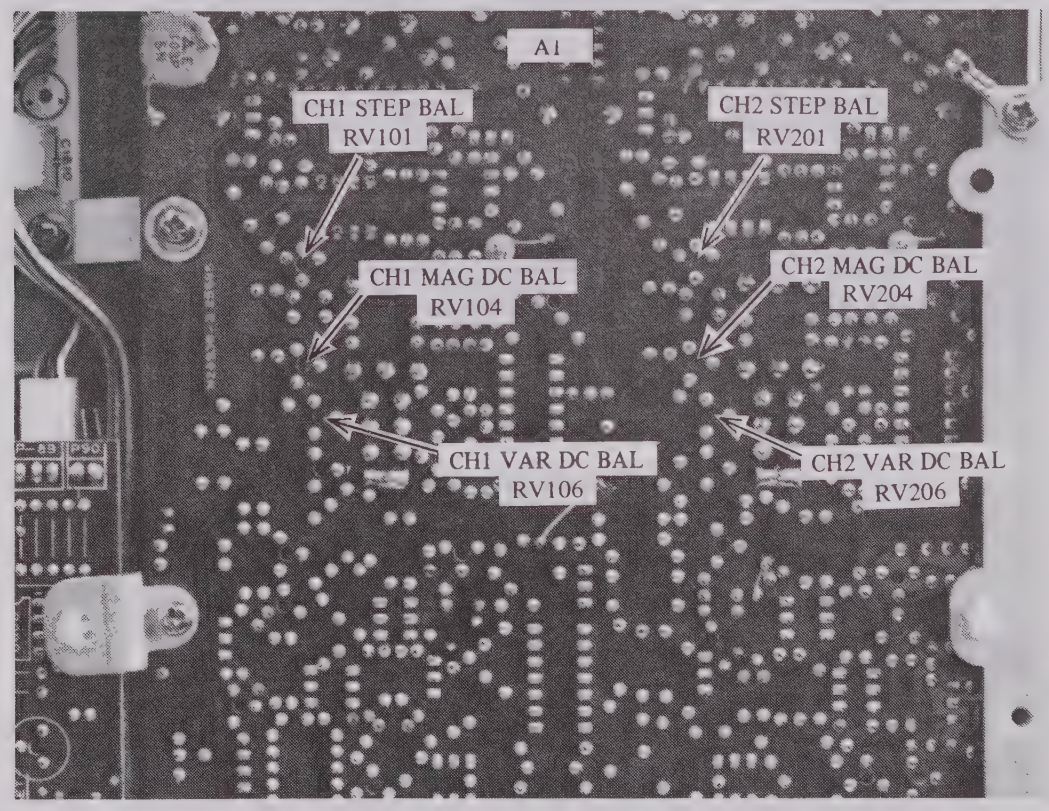


Fig. 4-7 CH1/CH2 STEP BAL (RV201, RV202),
CH1/CH2 MAG DC BAL (RV104, RV204),
CH1/CH2 VAR DC BAL (RV106, RV206) adjusting points

(d) Vertical axis sensitivity calibration

Calibrate the values on panel to actual sensitivity.

1) Initialize the oscilloscope according to Table 4-7.
2) Set TIME/DIV to 1 ms/DIV.
3) Apply an amplitude calibration signal from a vertical axis calibrator set at 50 mVp-p to the CH1 input terminal, and confirm that the sensitivity error for the 10 mV/DIV range is within ±3%.
   If the sensitivity error is not within ±3%, adjust the CH1 GAIN control (RV108) on the A1 board in Fig. 4-8.
4) Set VERT MODE to CH2.
5) Apply the amplitude calibration signal to the CH2 input terminal, and confirm that the sensitivity error for the 10 mV/DIV range is also within ±3%.
   If the sensitivity error is not within ±3%, adjust the CH2 GAIN control (RV208) on the A1 board in Fig. 4-8.

(e) x5MAG sensitivity calibration

Calibrate the x5MAG setting to the actual sensitivity.

1) Initialize the oscilloscope according to Table 4-7.
2) Set the CH1 input range to 50 mV, and turn on the x5MAG switch for CH1.
3) Apply an amplitude calibration signal from a vertical axis calibrator set at 50 mVp-p to the CH1 input terminal (open-circuit termination), and confirm that the CH1 sensitivity error is within ±5%.
   If the sensitivity error is not within ±5%, adjust the CH1 x5 GAIN control (RV102) on the A1 board shown in Fig. 4-8.
4) Set VERT MODE to CH2, and apply the above signal to CH2.
5) Confirm that the CH2 sensitivity error is also within ±5% when the x5MAG switch is on.
   If the sensitivity error is not within ±5%, adjust the CH2 x5 GAIN control (RV202) on the A1 board shown in Fig. 4-8.

(f) ADD BAL

This control is for matching the DC BAL of CH1 to that of CH2 in ADD mode.

1) Initialize the oscilloscope according to Table 4-7.
2) Set VERT MODE to the dual channel mode (press both CH1 and CH2 buttons).

3) Set the base lines for CH1 and CH2 exactly at the center of the CRT screen (place one base line on the other).

4) Set VERT MODE to ADD, and confirm that the base line may be shifted only within the range of ±0.5 DIV.
If the base line is shifted beyond the range of ±0.5 DIV, adjust the ADD BAL control (RV301) on the A1 board shown in Fig. 4-8.

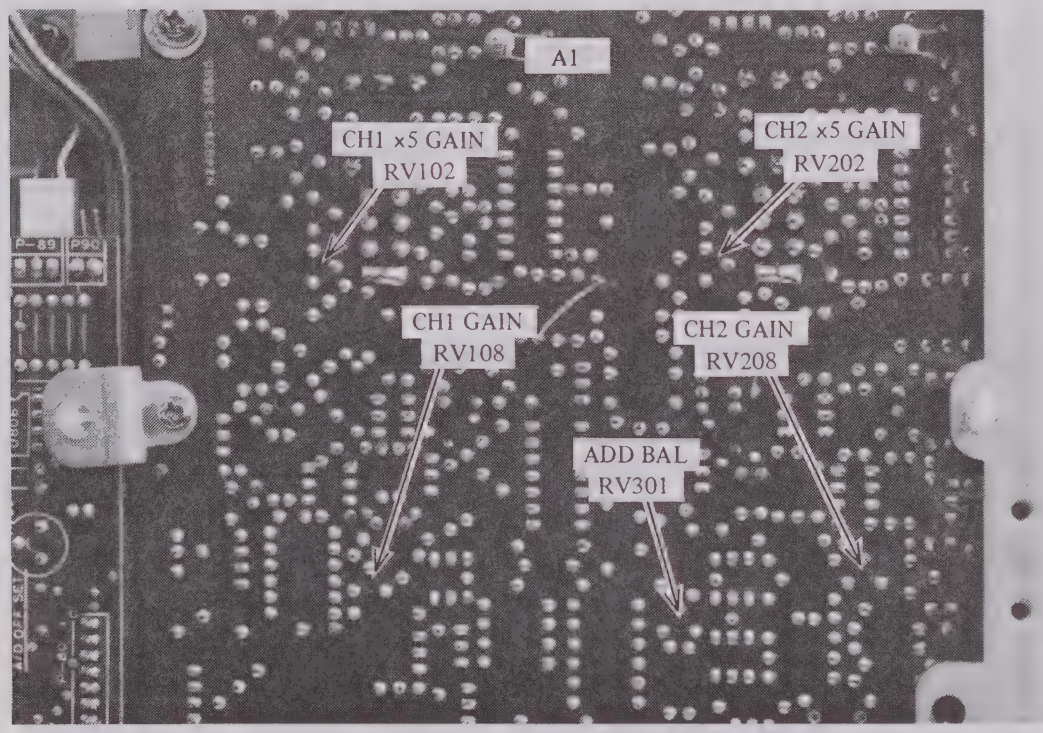


Fig. 4-8 CH1/CH2 GAIN (RV108, RV208),
CH1/CH2 ×5 GAIN (RV102, RV202),
ADD BAL (RV301) adjusting points

(g) Square waveform characteristic of vertical axis amplifier (middle range)

Adjust the vertical axis amplifier so that it will output a highly flat middle range square waveform.

1) Initialize the oscilloscope according to Table 4-7.
2) Set TIME/DIV to 0.2 μs/DIV.
3) Apply a high grade square waveform signal of about 1 MHz from a vertical axis calibrator to the CH1 input terminal (50Ω termination), and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 6 DIV.
4) Confirm that the flatness characteristic of the observed square waveform is as shown in chart (II) of Fig. 4-10. If the flatness characteristic as shown in chart (II) is not observed on the CRT screen, adjust the COMP(M) ADJ controls (RV302 and C316) and CH1 COMP(M) ADJ controls (RV107 and C128) alternately to obtain the maximum flatness characteristic. The controls are found on the A1 board shown in Fig. 4-9.
5) Set VERT MODE to CH2, and apply the above signal to the CH2 input terminal.
6) Confirm that the square waveform obtained through CH2 also has the flatness characteristic shown in chart (II) of Fig. 4-10. If it does not have the flatness characteristic shown in chart (II), adjust the CH2 COMP(M) ADJ controls (RV207 and C228) to obtain the maximum flatness characteristic. The controls are found on the A1 board shown in Fig. 4-9.

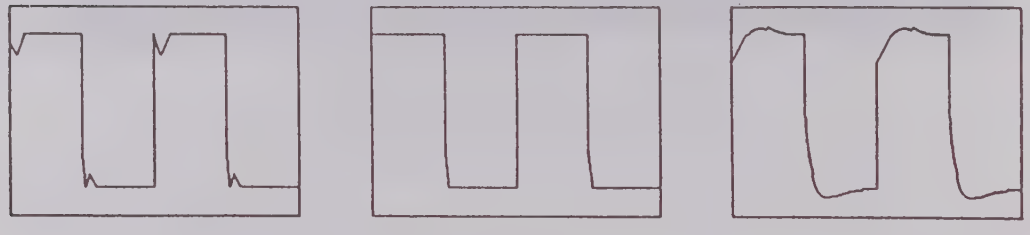


Fig. 4-10 Square Waveform Flatness Adjustment (Middle Range)

(h) Square waveform characteristic of vertical axis amplifier (high range)

1) Initialize the oscilloscope according to Table 4-7.
2) Set TIME/DIV to 0.2 μs/DIV.
3) Apply a high grade square waveform signal of about 1 MHz from a vertical axis calibrator to the CH1 input terminal (50 Ω termination), and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 6 DIV.

4) Confirm the flatness of the observed square waveform, especially that around the leading or trailing edges. If the observed square waveform does not have a good flatness characteristic especially around the leading or trailing edges, adjust the CH1 COMP(H) ADJ controls (RV103 and C122) alternately to obtain the maximum flatness characteristic. The controls are found on the A1 board shown in Fig. 4-9.

5) Set VERT MODE to CH2, and apply the above signal to the CH2 input terminal.

6) Confirm that the square waveform through CH2 also has a good flatness characteristic especially around the leading or trailing edges.
If it does not have a good flatness characteristic, adjust the CH2 COMP(H) ADJ controls (RV203 and C222) alternately to obtain the maximum flatness characteristic. The controls are found on the A1 board shown in Fig. 4-9.

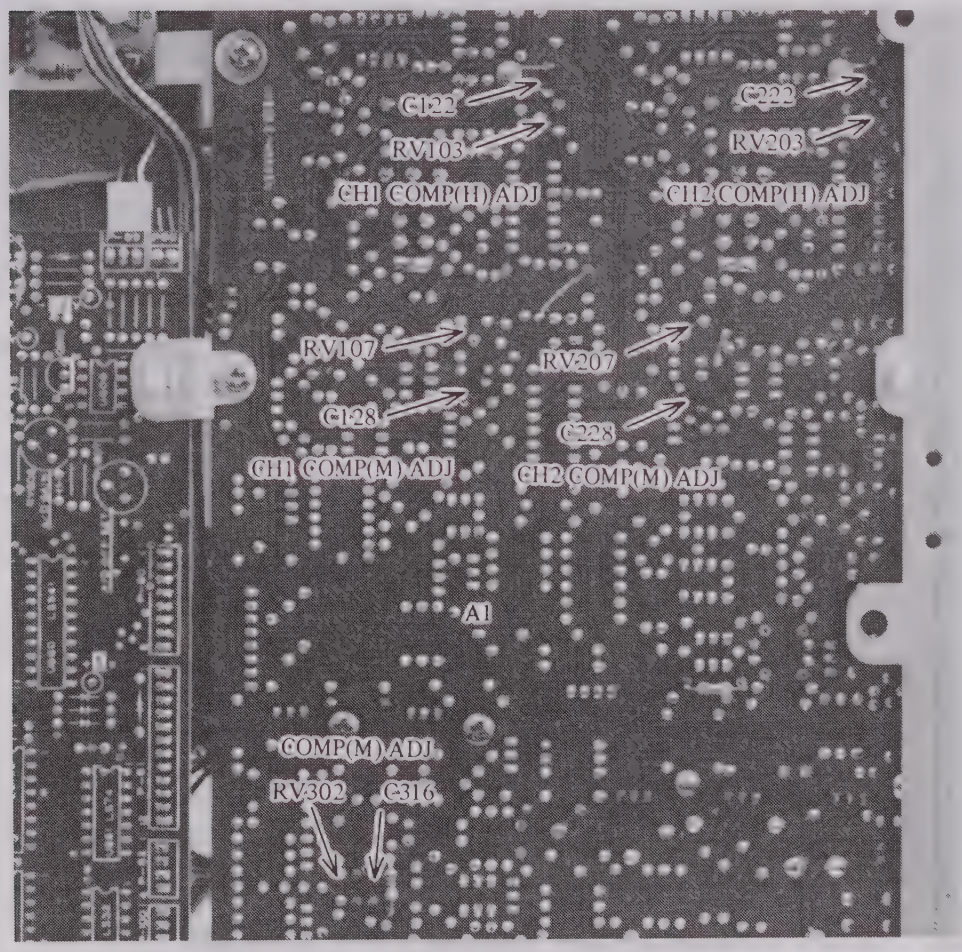


Fig. 4-10 Adjusting points of vertical amplifier for Square Waveform characteristics

(i) Input attenuator (ATT)

Calibrate the phase compensation and input capacitance of the input attenuator.

1) Initialize the oscilloscope according to Table 4-7.

2) Apply a high rade square waveform signal of about 1 kHz from a vertical axis calibrator to the CH1 input terminal (50 Ω termination), and set TIME/DIV of the oscilloscope to 0.5 ms/DIV.

3) Set the amplitude of the square waveform observed on the CRT screen to 6 DIV for each one of the CH1 ranges listed in Table 4-10, and confirm that the square waveform flatness characteristic is within ±3%.
If the flatness is not within ±3% adjust the CH1 phase compensation controls (C108 and C106) on the A1 board shown in Fig. 4-11.

4) Set VERT MODE to CH2, and apply the above signal to the CH2 input terminal.

5) Set the amplitude of the square waveform observed on the CRT screen to 6 DIV for each one of the CH2 ranges listed in Table 3.10, and confirm that the square waveform flatness characteristic is within ±3%.
If the flatness is not within ±3%, adjust the CH2 phase compensation controls (C208 and C306) on the A1 board shown in Fig. 4-11.

6) Connect a capacity meter to the CH1 input terminal.

7) Confirm that the input capacitance for each one of the CH1 ranges listed in Table 4-10 is 28 pF ±2 pF.
If the input capacitance is not 28 pF ±2 pF, adjust the CH1 input capacitance controls (C102 and C105) on the A1 board shown in Fig. 4-11.

8) Connect the capacity meter to the CH2 input terminal.

9) Confirm that the input capacitance for each one of the CH2 ranges listed in Table 4-10 is 28 pF ±2 pF.
If the input capacitance is not 28 pF ±2 pF, adjust the CH2 input capacitance controls (C202 and C205) on the A1 board shown in Fig. 4-11.

	CH1		CH2	
	Phase Compensation	Input capacitance	Phase Compensation	Input capacitance
0.1 V RANGE	C108	C102	C208	C202
1 V RANGE	C106	C105	C206	C205

Table 4-10 Input Attenuator (ATT) Adjustment

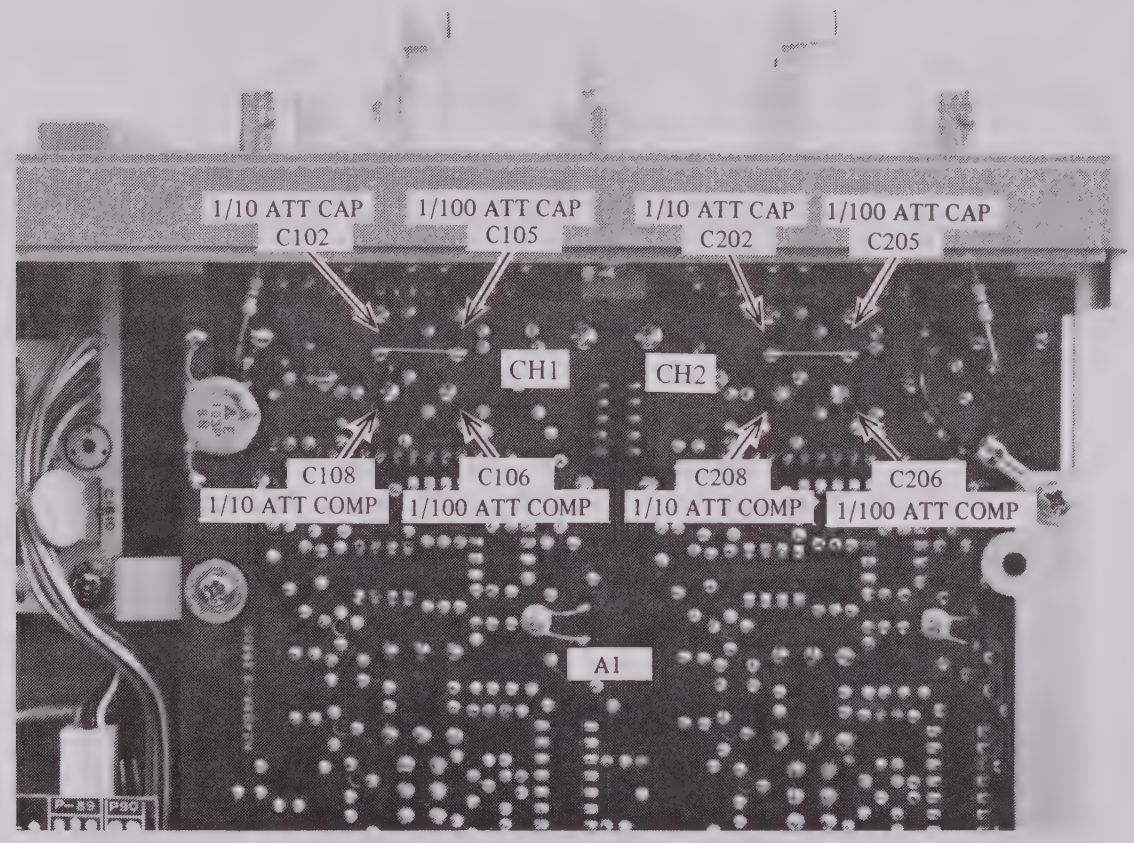


Fig. 4-11 Input attenuator adjusting point

(J) CH1 SIGNAL OUTPUT DC OFFSET

Set the DC offset of CH1 SIGNAL OUTPUT to zero.

CAUTION

This adjustment must be done after the adjustment of INT TRIG DC OFFSET for CH1 explained in Section (5) "Adjustment of trigger circuit".

1) Initialize the oscilloscope according to Table 4-7.
2) Set the CH1 input coupling to GND, and connect the CH1 SIGNAL OUTPUT terminal to the CH2 input terminal by a coaxial cable (50 Ω termination).
3) Set VERT MODE to CH2.
4) Confirm that the trace on the CRT screen may be shifted within the range of 1 DIV when the CH2 input coupling is switched as follows: DC → GND → DC. If the trace is shifted beyond the range of 1 DIV, adjust the CH1 SIGNAL OUTPUT DC OFFSET control (RV112) on the A1 board in Fig. 4-12.

(5) Adjustment of Trigger Circuit

TRIG DC OFFSET

Set the DC OFFSET of INT TRIG (CH1/CH2) to zero.

1) Initialize the oscilloscope according to Table 4-7.
2) Set the CH1 input coupling to AC.
3) Apply a signal of about 50 kHz from a signal generator to the CH1 input terminal, and adjust the signal till the amplitude of the waveform observed on CRT screen becomes 8 DIV.
4) Set TIME/DIV to 5 μs/DIV.
5) Adjust TRIG LEVEL to set the trigger point at the middle of the observed waveform amplitude.

6) Set TRIG COUPLING to DC.

7) Confirm that the trigger point is set at the middle of the observed waveform amplitude.
If the trigger point is not at the middle of the waveform amplitude, adjust the CH1 TRIG & X-AXIS DC OFFSET (RV110) control on the A1 board shown in Fig. 4-12.

8) Set VERT MODE to CH2.

9) Set the CH2 input coupling to AC, and apply the above signal to the CH2 input terminal.

10) Adjust TRIG LEVEL to set the trigger point at the middle of the observed waveform amplitude.

11) Set TRIG COUPLING to DC.

12) Confirm that the trigger point is set at the middle of the observed waveform amplitude.
If the trigger point is not at the middle of the waveform amplitude, adjust the CH2 TRIG DC OFFSET control (RV210) on the A1 board in Fig. 4-12.

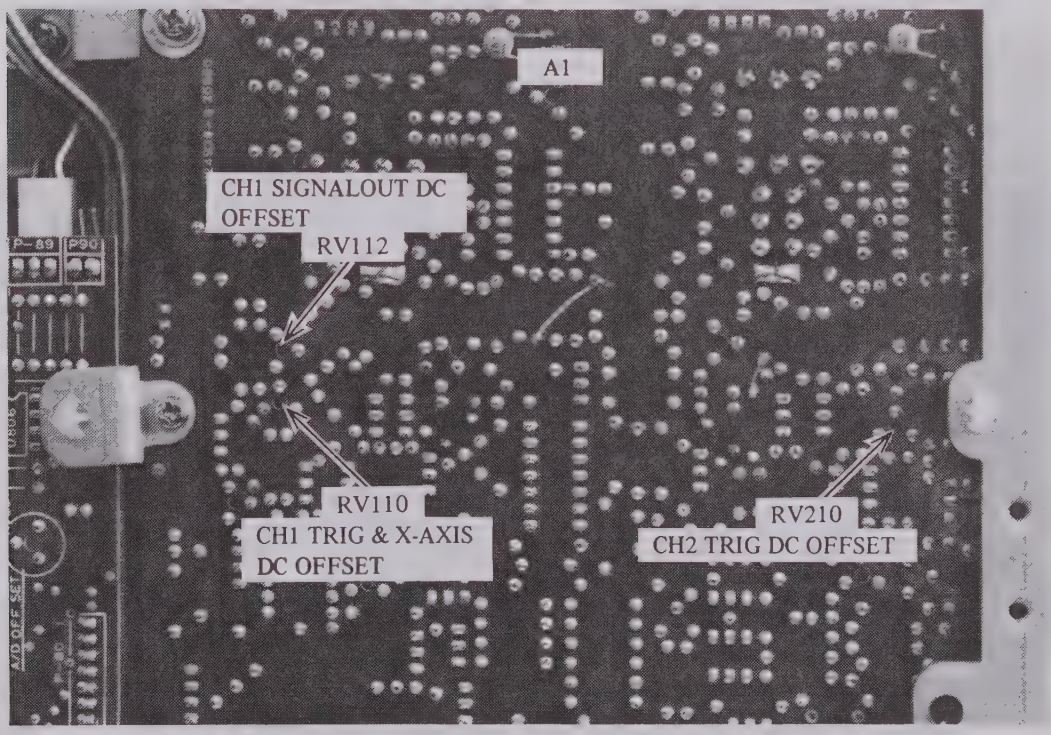


Fig. 4-12 CH1 SIGNAL OUTPUT DC OFFSET (RV112);
INT TRIG DC OFFSET (RV110, RV210) adjusting points

(6) Time axis adjustment

(a) Calibration of sweep time

Calibrate the actual sweep speed to the value on panel.

1) Initialize the oscilloscope according to Table 4-7.

2) Apply a signal from a time marker set at 1 ms to the CH1 input terminal (50 Ω termination), and adjust the input sensitivity of the oscilloscope till the amplitude of the waveform observed on the CRT screen becomes approximately 2 DIV.

3) Confirm that the display cycle of the waveform observed on the CRT screen is 1 ms ±3%.
If the display cycle is not 1 ms ±3%, adjust the 1 ms CAL control (RV403) on the A2 board in Fig. 4-13.

4) Set the cycle of the time marker signal to 1 μs.

5) Set TIME/DIV to 1 μs/DIV.

6) Confirm that the display cycle of the waveform observed on the CRT screen is 1 μs ±3%.
If the display cycle is not 1 μs ±3%, adjust the 1 μs CAL control (RV402) on the A2 board in Fig. 4-13.

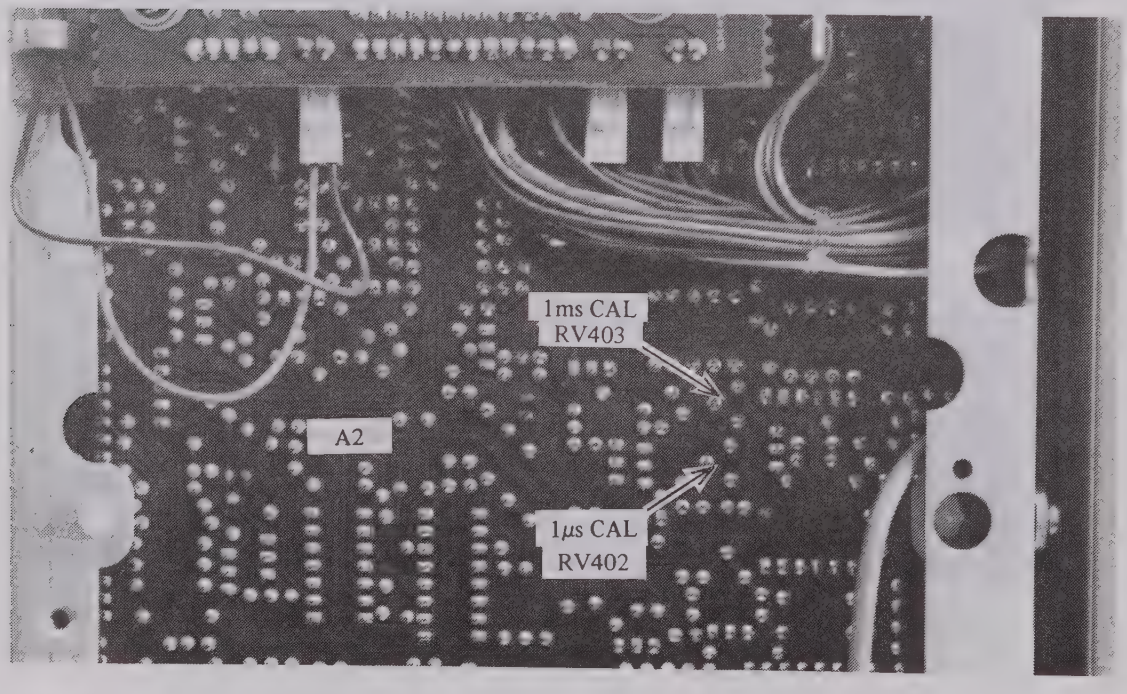


Fig. 4-13 1 ms ADJ (RV403) with 1 μs ADJ (RV402) adjusting points

(7) Horizontal axis (X axis) adjustment

(a) Horizontal sensitivity adjustment

Adjust the actual sensitivity (X-Y operation mode) to the value on panel.

1) Initialize the oscilloscope according to Table 4-7.

2) Set VERT MODE to CH2.

3) Set INT TRIG to CH1.

4) Set TRIG COUPLING to DC.

5) Set TIME/DIV to EXT HOR or X-Y.

6) Apply an amplitude calibration signal from a vertical axis calibrator set at 100 mVp-p to the X input terminal (CH1) (open termination), and confirm that the sensitivity error for the 10 mV/DIV range is within ±3%.
If the sensitivity error is not within ±3%, adjust the X-GAIN control (RV109) on the A1 board shown in Fig. 4-14.

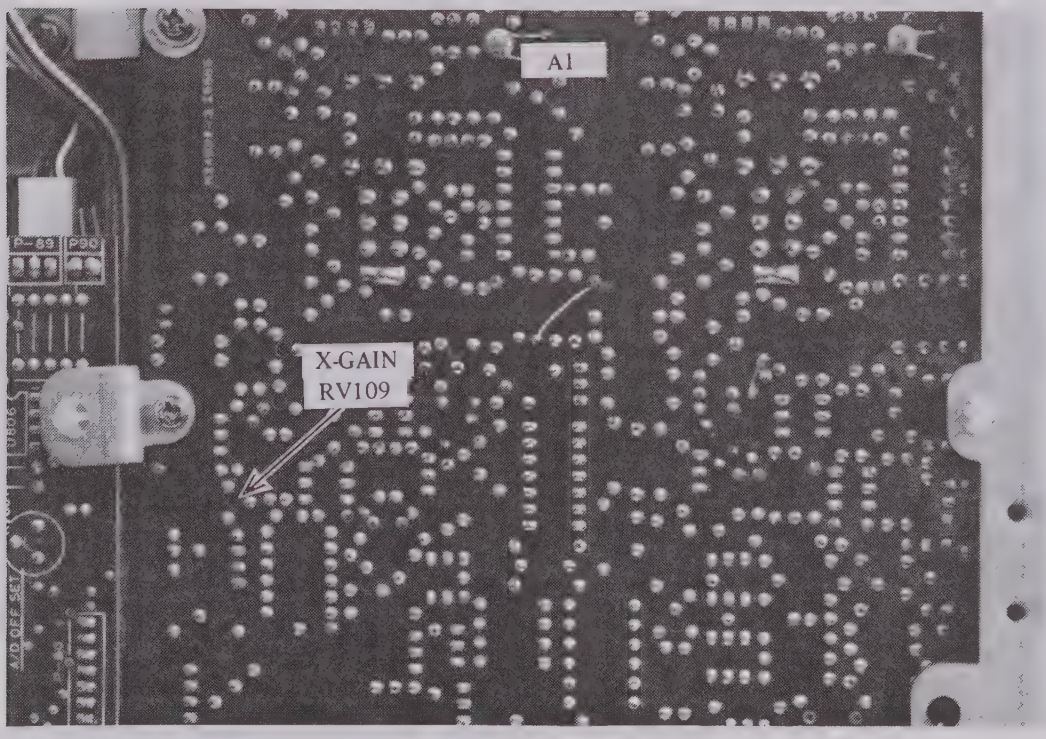


Fig. 4-14 X-GAIN (RV109) adjusting points

(b) X-Y POSITION adjustment

Adjust the relationship between the sweep starting position in normal mode and the beam spot position in X-Y mode.

1) Initialize the oscilloscope according to Table 4-7.
2) Set the A sweep starting point at the left edge of the scale on CRT screen by adjusting H POSITION.
3) Set VERT MODE to CH2.
4) Set INT TRIG to CH1.
5) Set TRIG COUPLING to DC.
6) Set TIME/DIV to EXT HOR or X-Y.
7) Confirm that the beam spot is at the center of CRT screen ±1 DIV.
If the beam spot is not found at the center of the CRT screen ±1 DIV, adjust the X AXIS DC OFFSET control (RV401) on the A2 board shown in Fig. 4-15.

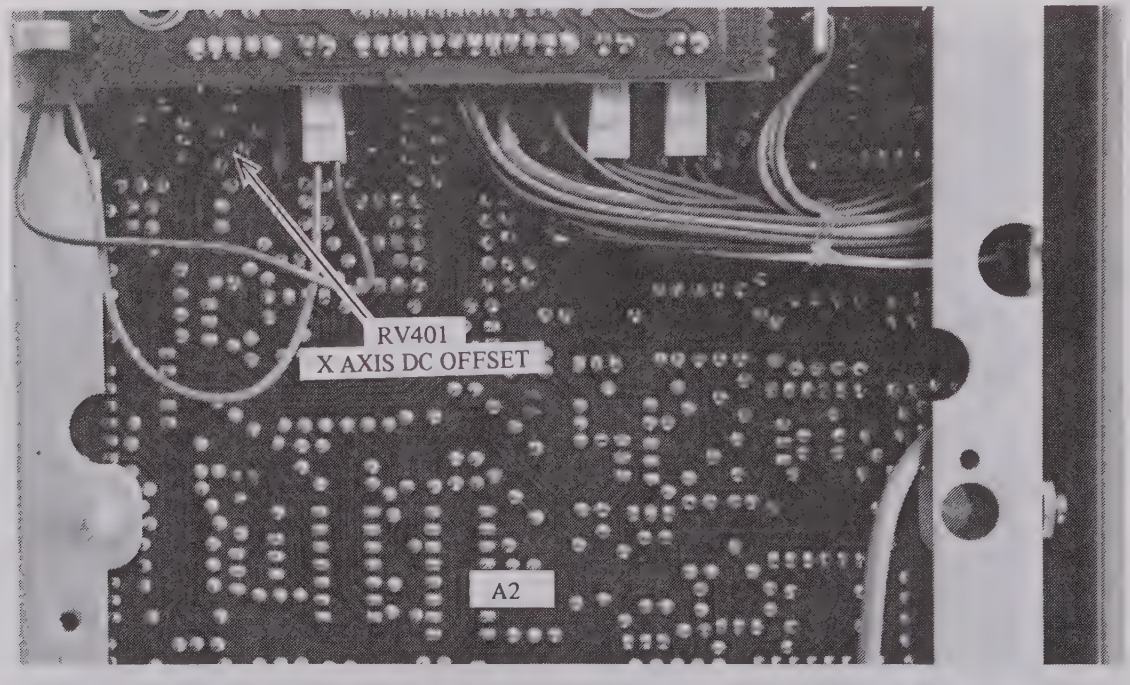


Fig. 4-15 X AXIS DC OFFSET (RV401) adjusting points

(8) Adjustment of Storage group

a) Display format of Service Waveform

1) Initial set the oscilloscope according to Table 4-7.

2) Set "VERT MODE" on "CH2" offset, and set input coupling as "GND".

3) Turn "CH2 POSITION", shift the bright line of CH2 at the center of the CRT screen.

4) Turn "CH2 INV" ON/OFF, confirm that the shift of the bright line of "CH2" stands within ±0.2 DIV. And if it does not stand within ±0.2 DIV, with turning the "CH2 POSITION", turn "CH2 INV" ON/OFF so as the bright line of "CH2" shifts within ±0.2 DIV. (Adjust the shift of bright line becomes as nil as much as possible.)

5) Confirm that the bright line of CH2 is at the center of CRT screen. And if it is not at the center position, adjust by "DISPLAY CENTER" in the center point between "INTEN" and "FOCUS" knobs.

6) Select "STORAGE/REAL" to "STORAGE".

7) When short-circuit the P90 connector of A5 PCB as per Fig. 4-17, waveform (service waveform) displays on CRT screen as by Fig. 4-16.

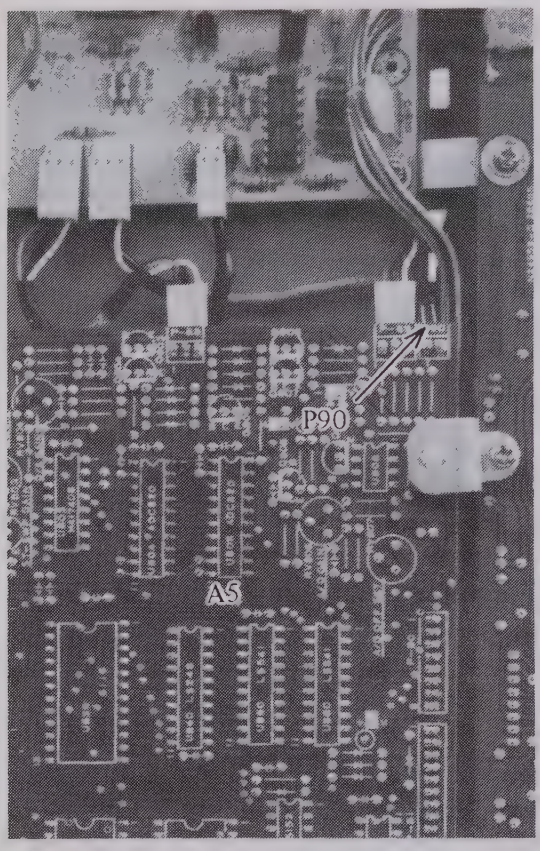


Fig. 4-17 P90 Connector Position

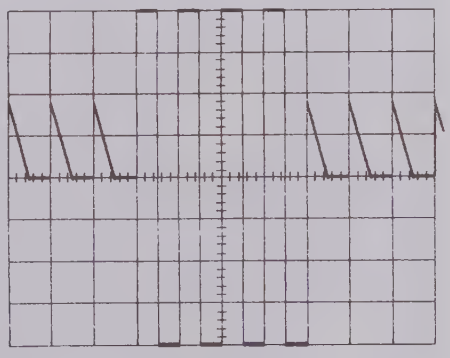


Fig. 4-16 Service Waveform

b) Adjustment of D/A Offset

1) Display test pattern as per Fig. 4-19.

2) Confirm that the vertical position of the service is at the center of CRT screen as per Fig. 4-18. If the vertical position of the service waveform is not found at the center of CRT screen, adjust D/A Offset (RV801) of A5 PCB as per Fig. 4-19.

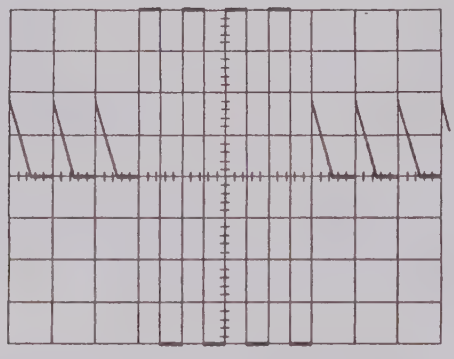


Fig. 4-18 Service waveform

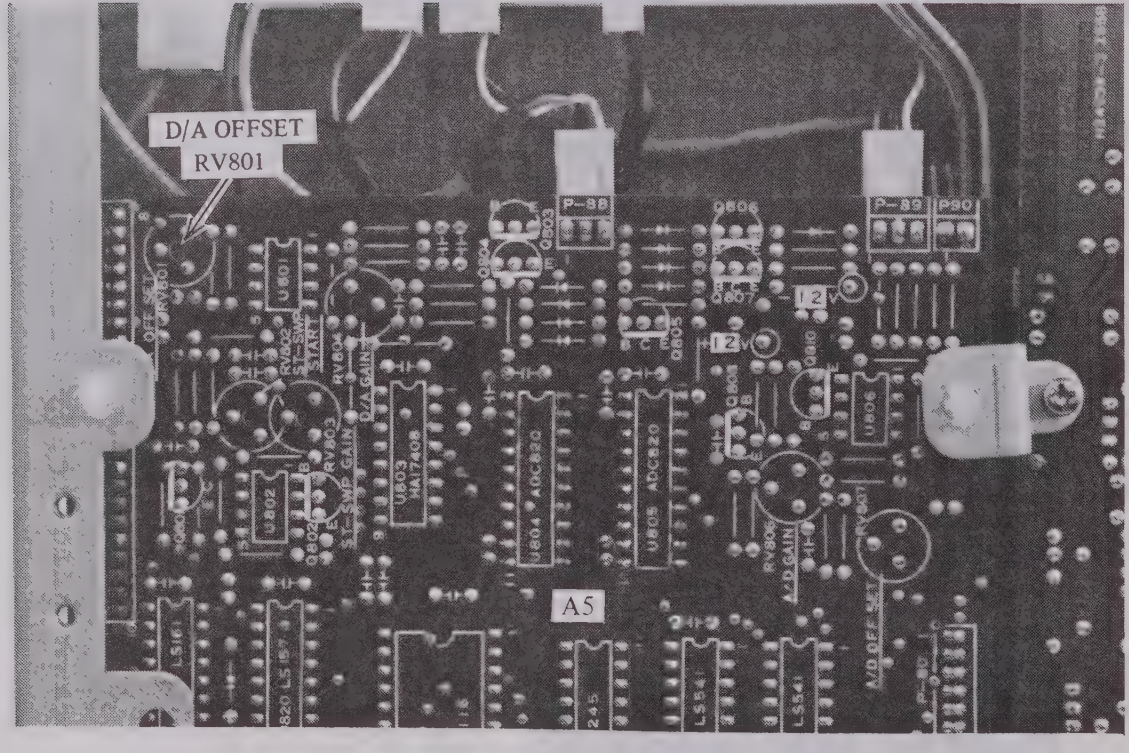


Fig. 4-19 D/A OFFSET (RV801) adjusting point

c) Adjustment of D/A Gain

1) Display service waveform.

2) Confirm that the amplitude of test pattern square wave is within the range of 8 DIV ± 0.1 DIV. If the amplitude of square wave is not observed within the range of 8 DIV ± 0.1 DIV, adjust the D/A Gain (RV804) of A5 PCB as per Fig. 4-21.

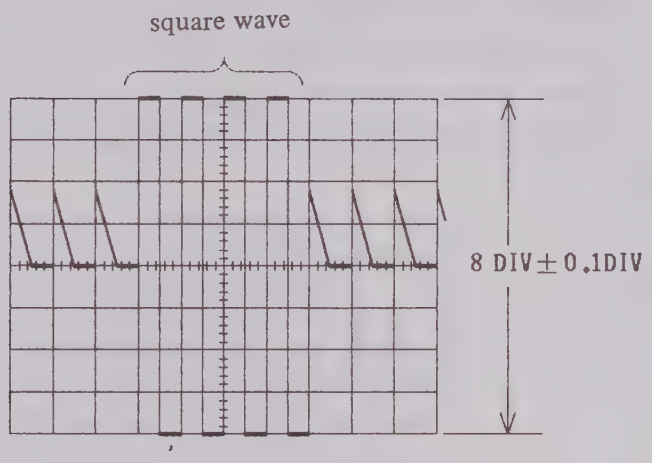


Fig. 4-20 Service waveform

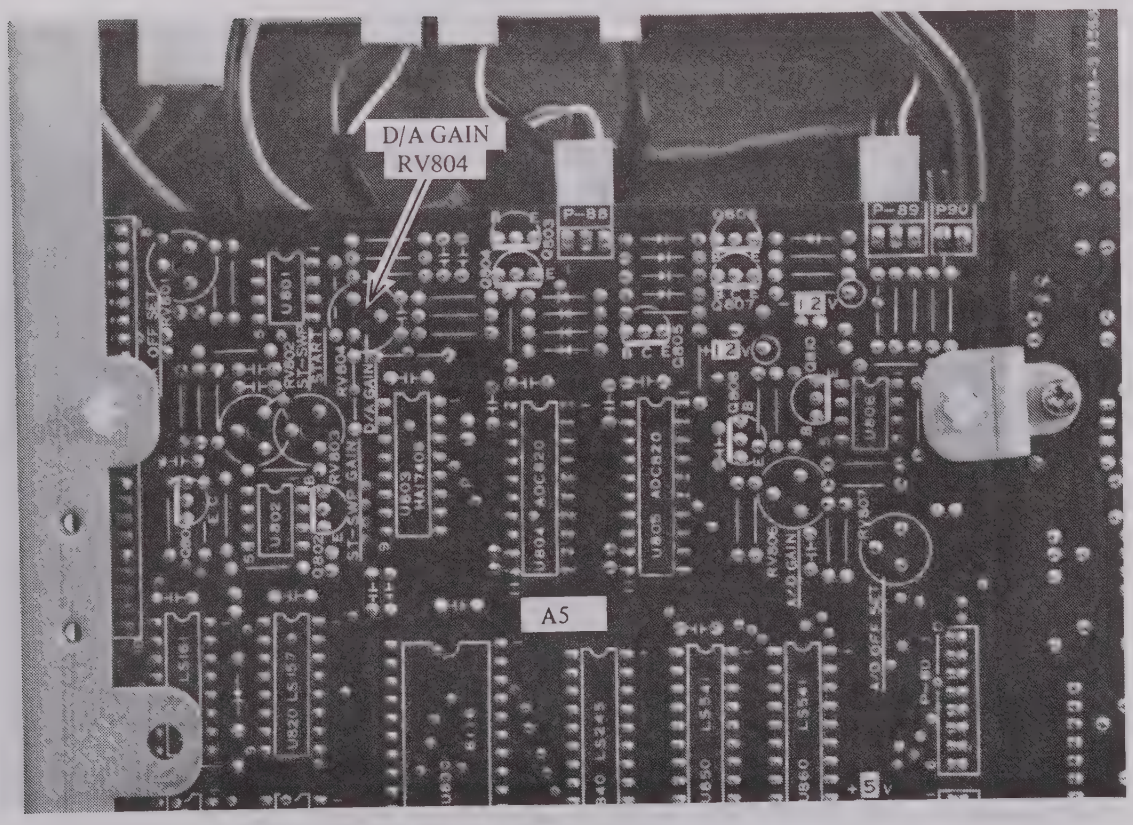


Fig. 4-21 D/A GAIN (RV804) Adjusting point

d) Adjustment of Sweep Start

1) Initialize the oscilloscope according to Table 4-7.

2) Set "VERT MODE" to "CH2", and set the CH2 input coupling to "GND".

3) Set the sweep starting point at the left edge of the scale on CRT screen.

4) Display service waveform as per Fig. 4-22. (Refer "(a) display format of service waveform" as to the display format of service waveform.)

5) Confirm that the starting point is within the range of ± 0.1 DIV from the left edge of the sclae. If the starting point is not observed within the range of ± 0.1 DIV, adjust the SWEEP START (RV802) as per Fig. 4-23.

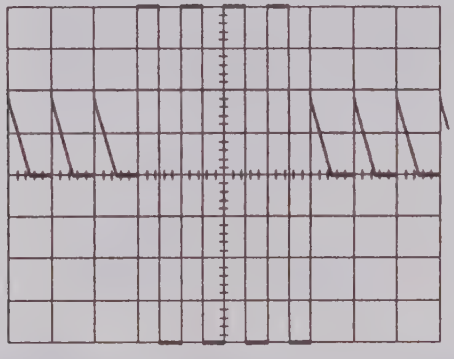


Fig. 4-22 Service Waveform

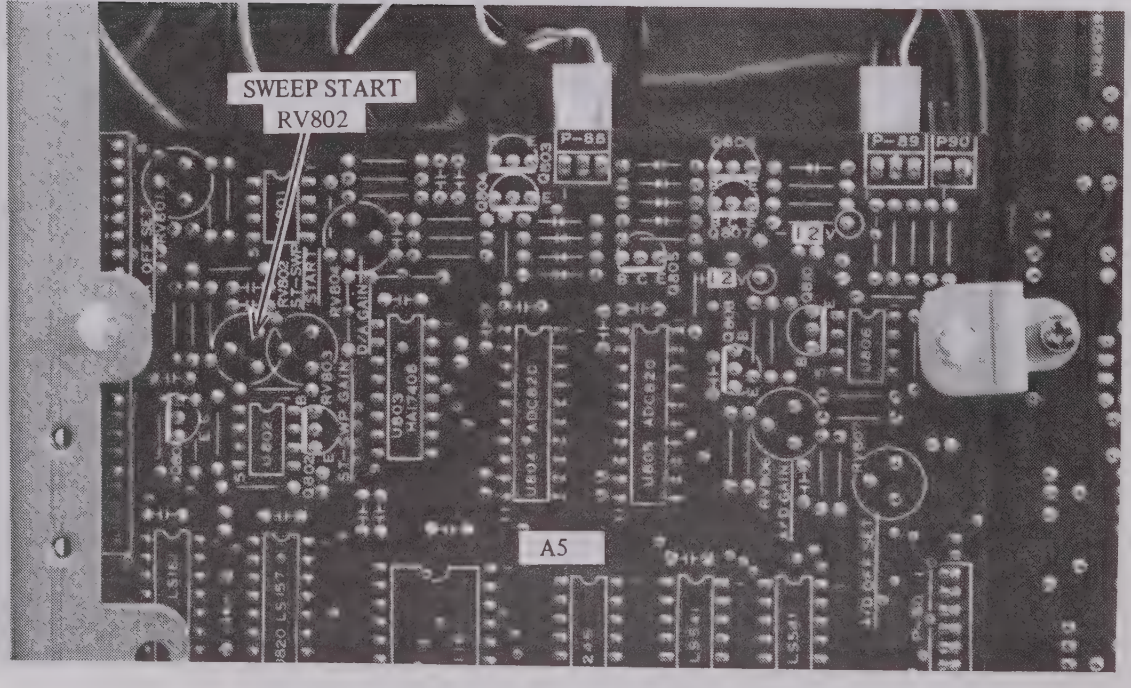


Fig. 4-23 SWEEP START (RV802) adjusting point

e) Adjustment of SWEEP GAIN

1) Display test pattern as per Fig. 4-24. (Refer "a) display format of service waveform" as to the display format.

2) Confirm that the second and tenth leading edge of the service waveform (the first and nineth DIV) is within the range of ± 0.1 DIV to the scale. And if the second and the tenth is not found within the range of ± 0.1 DIV to the scale, adjust the SWEEP GAIN (RV803) of A5 PCB as per Fig. 4-25.

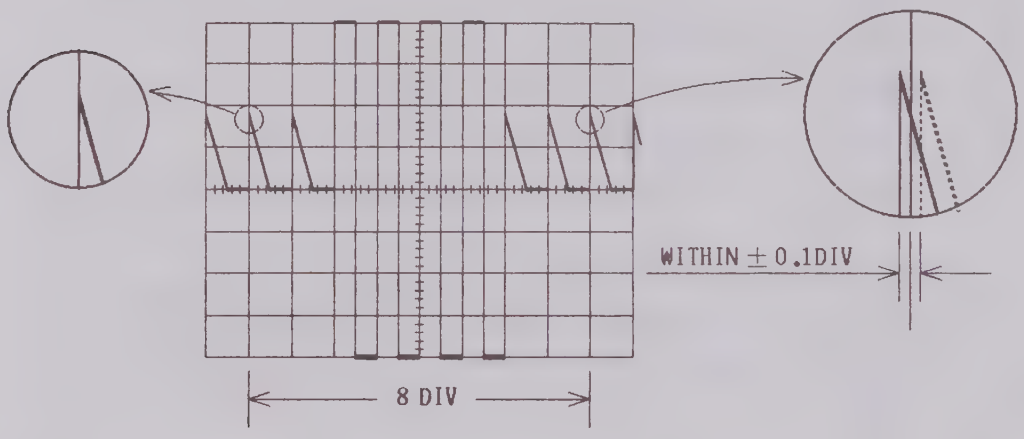


Fig. 4-24 Service Waveform

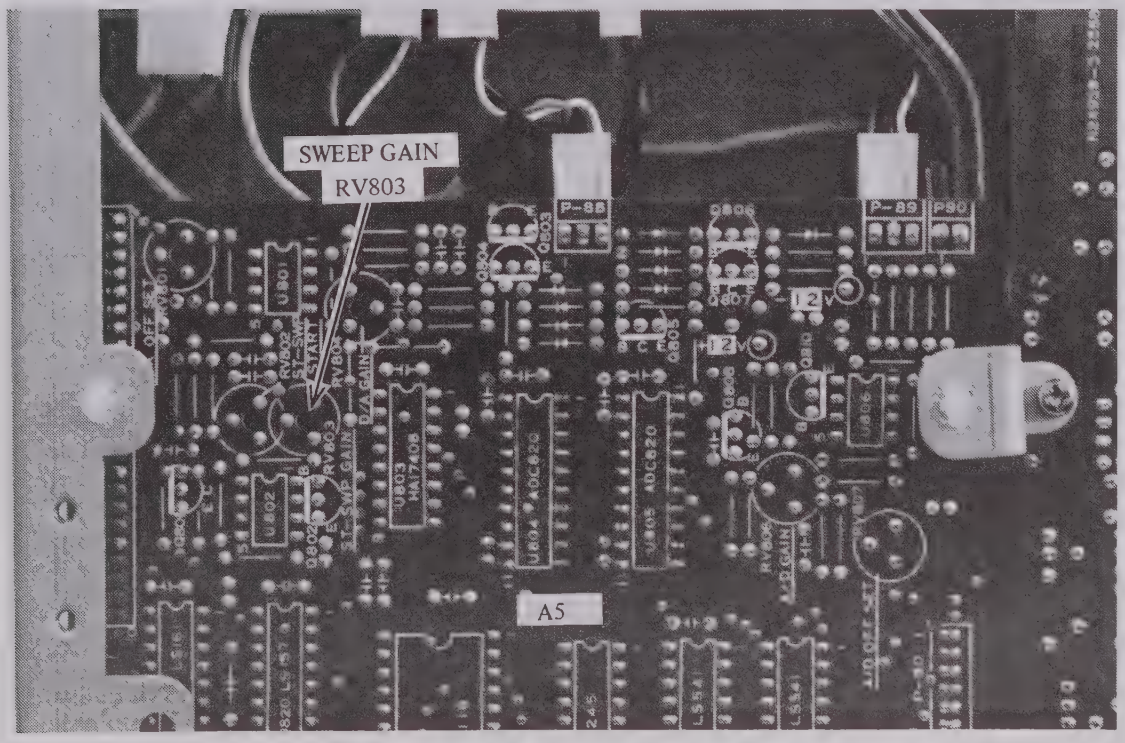


Fig. 4-25 SWEEP GAIN (RV803) adjusting point

f) Adjustment of A/D GAIN

1) Initialize the oscilloscope according to Table 4-7.

2) Select "STORAGE/REAL" to "STORAGE".

3) Connect the amplitude calibration signal output on 50 mVp-p with the input terminal of CH1 (with its open end), and confirm that the sensitivity error of the 10 mV/DIV is within the range of ±3%. And if its sensitivity error comes beyond the range of ±3%, adjust the A/D GAIN (RV806) of A5 PCB as per Fig. 4-26.

g) Adjustment of A/D OFFSET

1) Initialize the oscilloscope according to Table 4-7.

2) Set the CH1 input coupling to "GND".

3) Turn the "CH1 POSITION", and shift the beam spot of CH1 to the center of CRT screen.

4) Change the "STORAGE/REAL", and confirm that the bright line of the CH1 does not shift on the vertical direction. And if the bright line shift on the vertical axis, adjust A/D OFFSET (RV807) of A5 PCB as per Fig. 4-26.

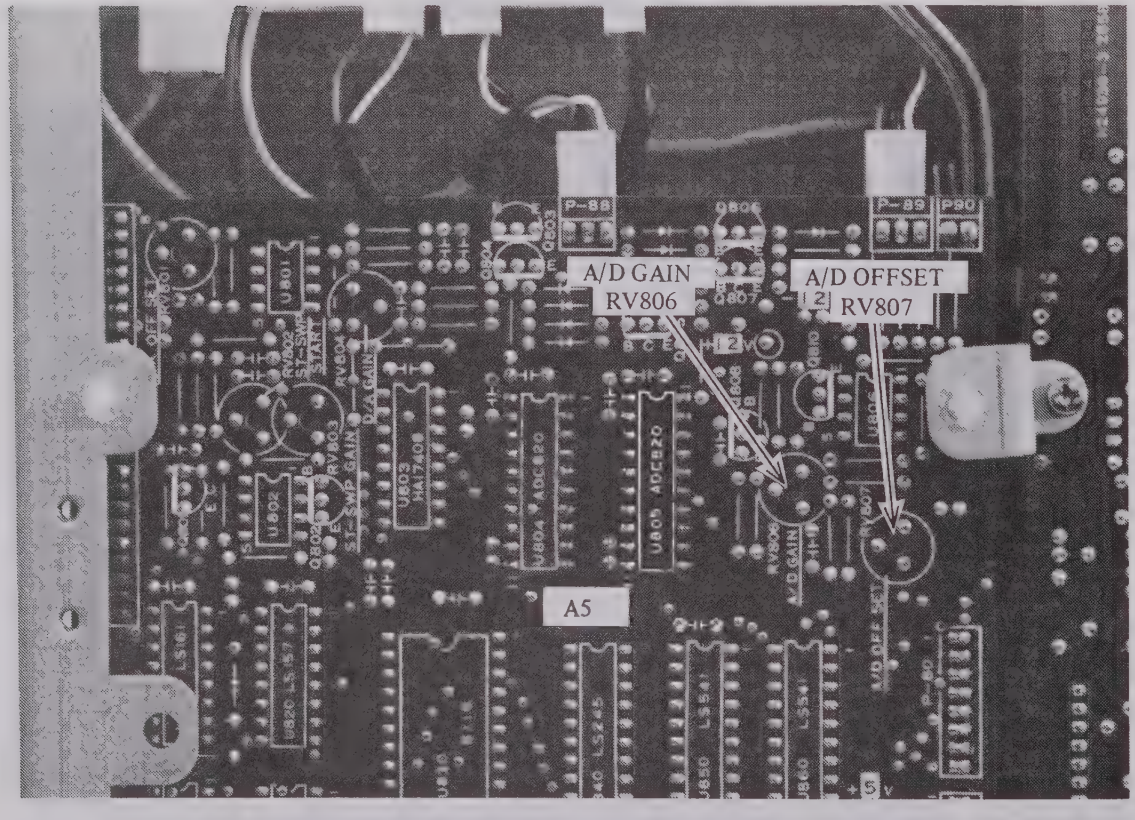


Fig. 4-26 A/D GAIN (RV806), A/D OFFSET (RV807) adjusting point

4.3.5 Adjustment Parts Location

The list of specified adjustment parts for calibrating the oscilloscope are shown on Tables 4-11, and their locations by each PCB on Figures 4-27, 4-28 and 4-29.

No.	Specifications	Adjusting points	Circuit no.	PCB
1	Power source voltage adjustment	+12V ADJ	RV606	A1
2	SUB INTEN adjustment	SUB INTEN	RV653	A2
3	SUB FOCUS adjustment	SUB FOCUS	RV651	A2
4	ASTIG adjustment	ASTIG	RV652	A2
5	Vertical axis DC balance adjustment	CH1 STEP BAL	RV101	A1
6		C112 STEP BAL	RV201	A1
7		CH1 MAG DC BAL	RV104	A1
8		CH2 MAG DC BAL	RV204	A1
9		CH1 VAR DC BAL	RV106	A1
10		CH2 VAR DC BAL	RV206	A1
11	Vertical axis sensitivity adjustment	CH1 GAIN	RV108	A1
12		CH2 GAIN	RV208	A1
13	Vertical axis sensitivity adjustment (x5MAG)	CH1 x5 GAIN	RV102	A1
14		CH2 x5 GAIN	RV202	A1
15	Vertical DC balance adjustment	ADD BAL	RV301	A1
16	Vertical axis square wave characteristics	COMP(M) ADJ	RV302	A1
17			C316	A1
18		CH1 COMP(M) ADJ	RV107	A1
19			C128	A1
20		CH2 COMP(M) ADJ	RV207	A1
21			C228	A1
22		CH1 COMP(H) ADJ	RV103	A1
23			C122	A1
24		CH2 COMP(H) ADJ	RV203	A1
25			C222	A1
26	Imput attenuator adjustment	CH1 1/10 ATT COMP	C108	A1
27		CH1 1/100 ATT COMP	C106	A1
28		CH2 1/10 ATT COMP	C208	A1
29		CH2 1/100 ATT COMP	C206	A1
30		CH1 1/10 ATT CAP	C102	A1
31		CH1 1/100 ATT CAP	C105	A1
32		CH2 1/10 ATT CAP	C202	A1
33		CH2 1/100 ATT CAP	C205	A1
34	CH1 signal output DC OFFSET adjustment	CH1 SIGNALOUT DC OFFSET	RV112	A1
35	Inner trigger DC OFFSET adjustment	CH1 TRIG & X-AXIS DCOFFSET	RV110	A1
36	Inner trigger DC OFFSET adjustment	CH2 TRIG DC OFFSET	RV210	A1
37	Time axis adjustment	1ms CAL	RV403	A2
38		1μs CAL	RV402	A2
39	Horizontal axis adjustment	X-GAIN	RV109	A1
40	X-Y POSITION adjustment	X AXIS DC OFFSET	RV401	A2
41	D/A OFFSET adjustment	D/A OFFSET	RV801	A5
42	D/A GAIN adjustment	D/A GAIN	RV804	A5
43	SWEEP START adjustment	SWEET START	RV802	A5
44	SWEEP GAIN adjustment	SWEEP GAIN	RV803	A5
45	A/D GAIN adjustment	A/D GAIN	RV806	A5
46	A/D OFFSET adjustment	A/D OFFSET	RV807	A5

Table 4-11 List of Adjustment Parts

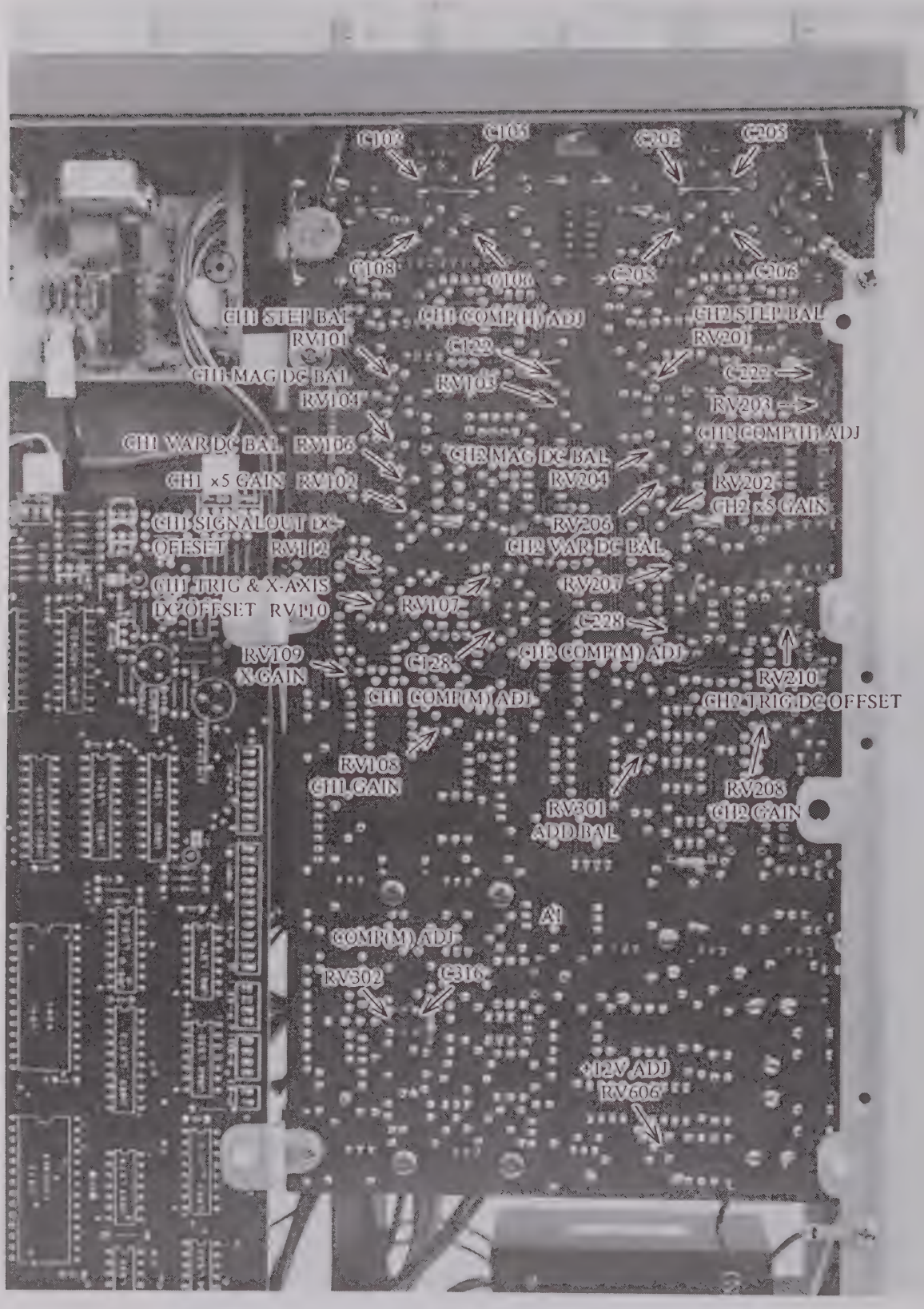


Fig. 4-27 Distribution of A1 PCB Adjustment Parts

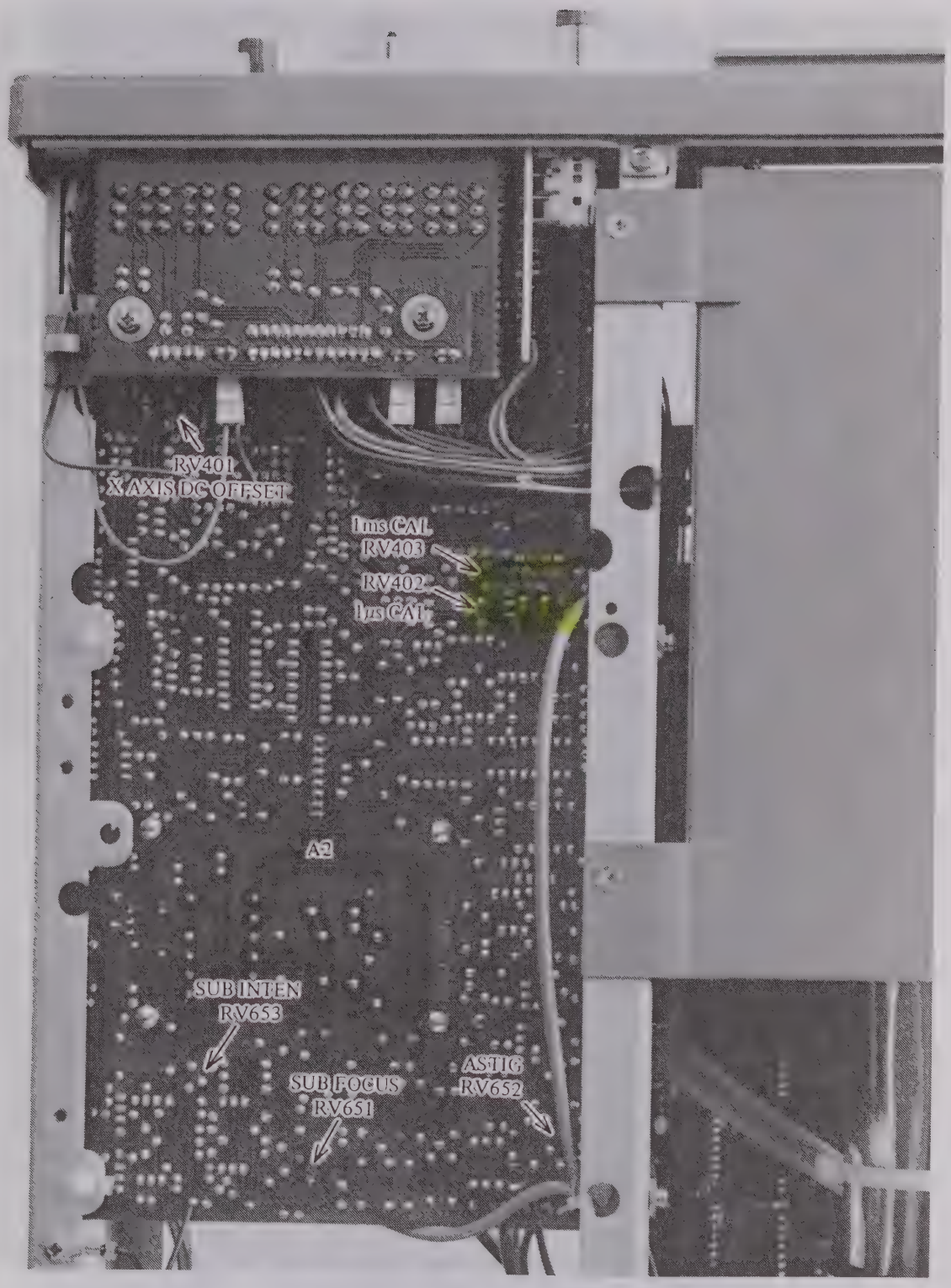


Fig. 4-28 Distribution of A2 PCB Adjustment Parts

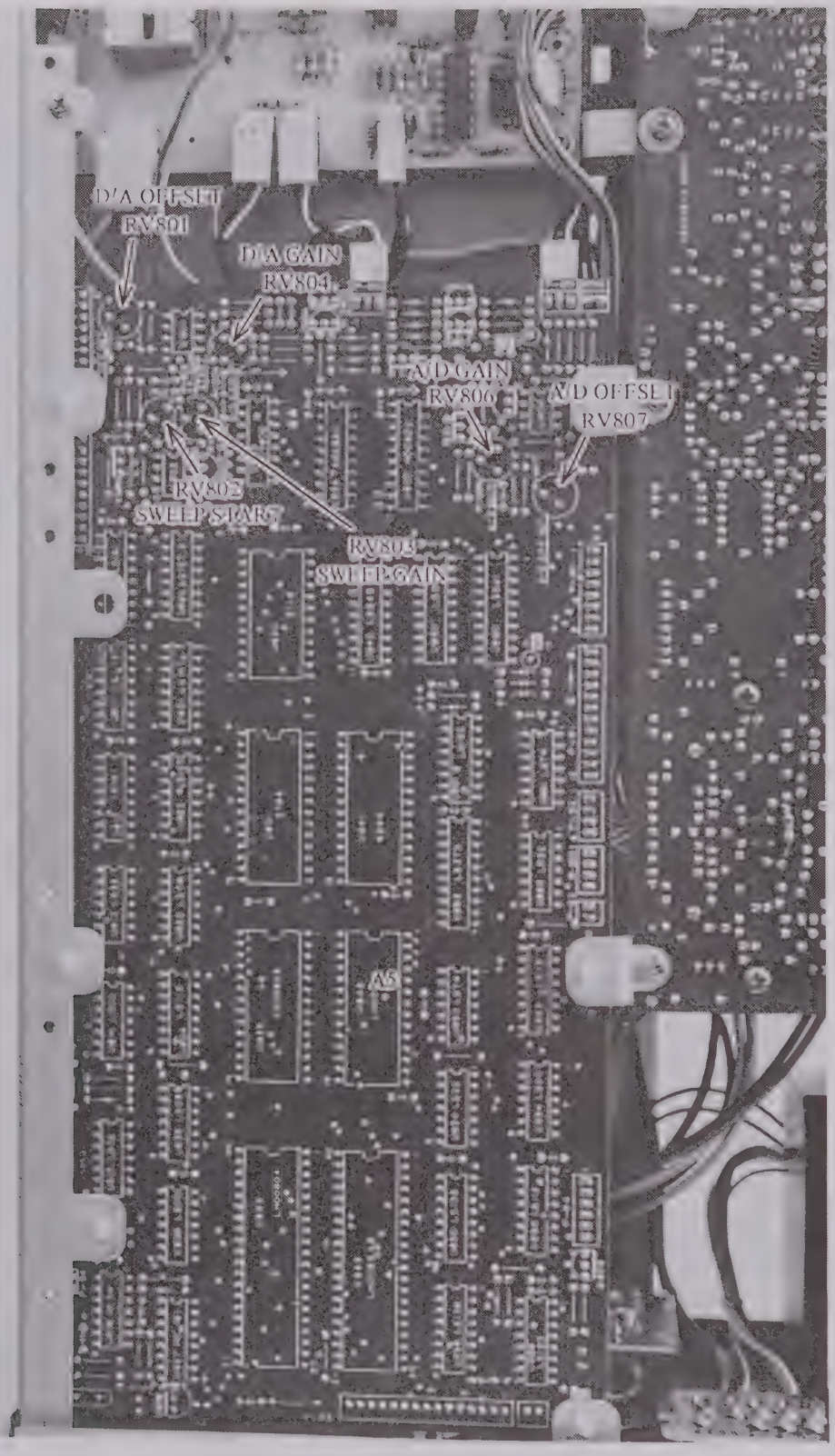


Fig. 4-29 Location of A5 PCB Adjustment Parts

4.4 TROUBLESHOOTING

4.4.1 Summary

When there found something wrong in its operation, check all the functional point by operation, first of all.

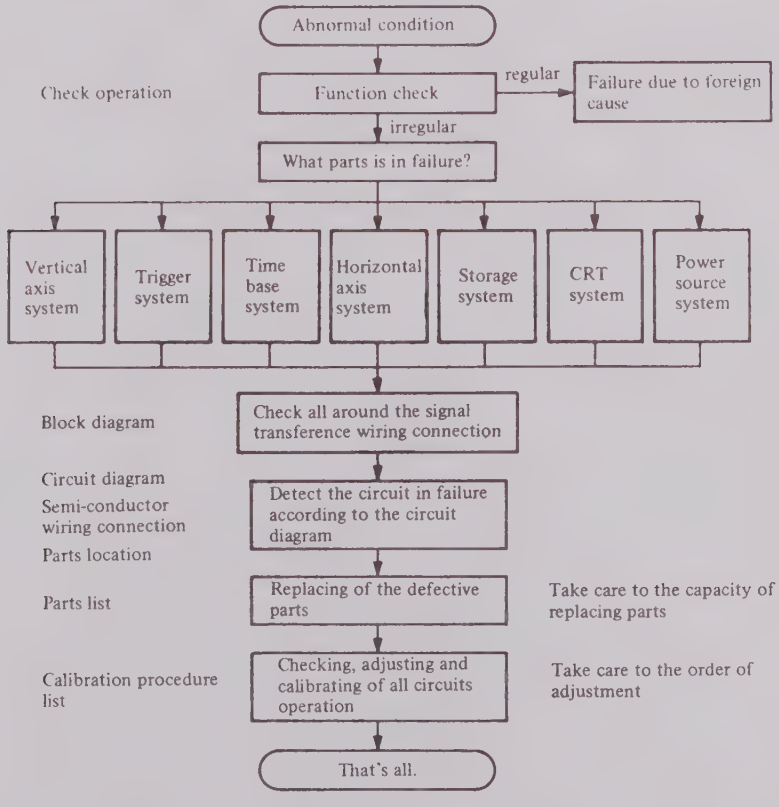
In case confirmed malfunction in the action check if ever, inspect what part of oscilloscope works in failure (as the part belongs either to the vertical or horizontal axis or CRT sequences) and take just the point of the signal transference routine around the defective parts in connection with the network by the block diagram.

And detect the circuit in trouble, by making use of circuit diagram and based upon all those symptoms of power voltages of each parts and displaying waveforms.

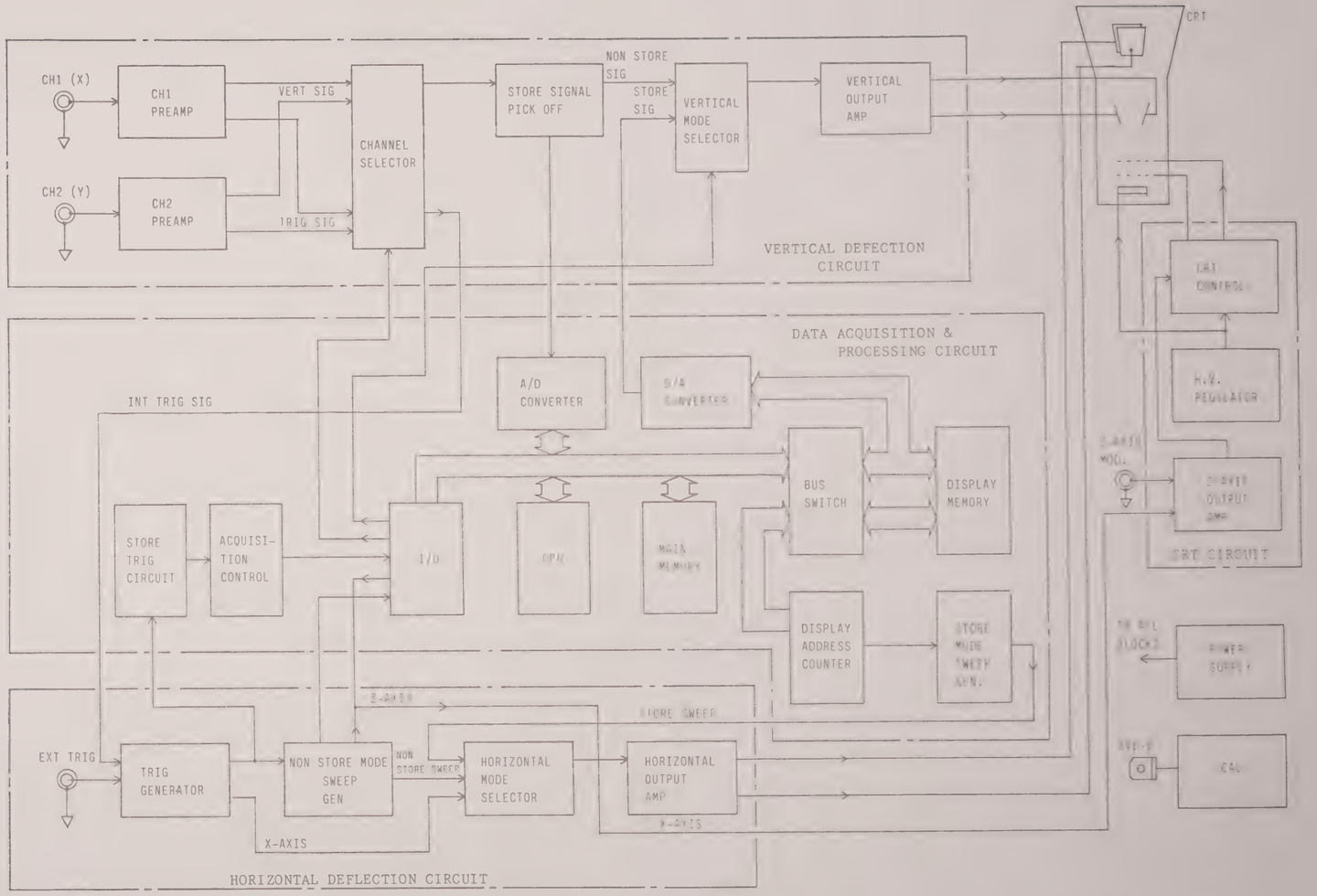
All those of parts terminal wiring connection, and parts location on each PCB should be of great aid in case of detecting failure.

Upon detected an irregular circuit, and found an abnormal parts, inspect the capacity of the parts in question according to the parts list (of electronic). Since the instrument is comprised of some particular specified ones in some circuitries. Apply our specified parts or the equivalent ones based on the full knowledge of the efficiency of the parts used.

And after made some repairs, be sure to take necessary steps for each calibrating items with the adjustment of the defective points and in whole operation in context with the repairment of some parts.



4 .4 .2 Block Diagram



BLOCK DIAGRAM

4.4.3 Circuit Diagram

COS 5020A VERT AMP ◇1 ---------- 83

COS 5020A TRIGGER & SWEEP ◇2 ---------- 85

COS 5020A HV & POWER SUPPLY ◇3 ---------- 87

COS 5020A A5 PROCESSING UNIT ◇4 ---------- 89

COS 5020A X-Y RECORDER OUT ◇5 ---------- 91

COS 5020A A5 POWER DISTRIBUTION ◇6 ---------- 93

★ Some of the units and functions of the parts shown in Table 4-13 have been omitted from the circuit diagrams.

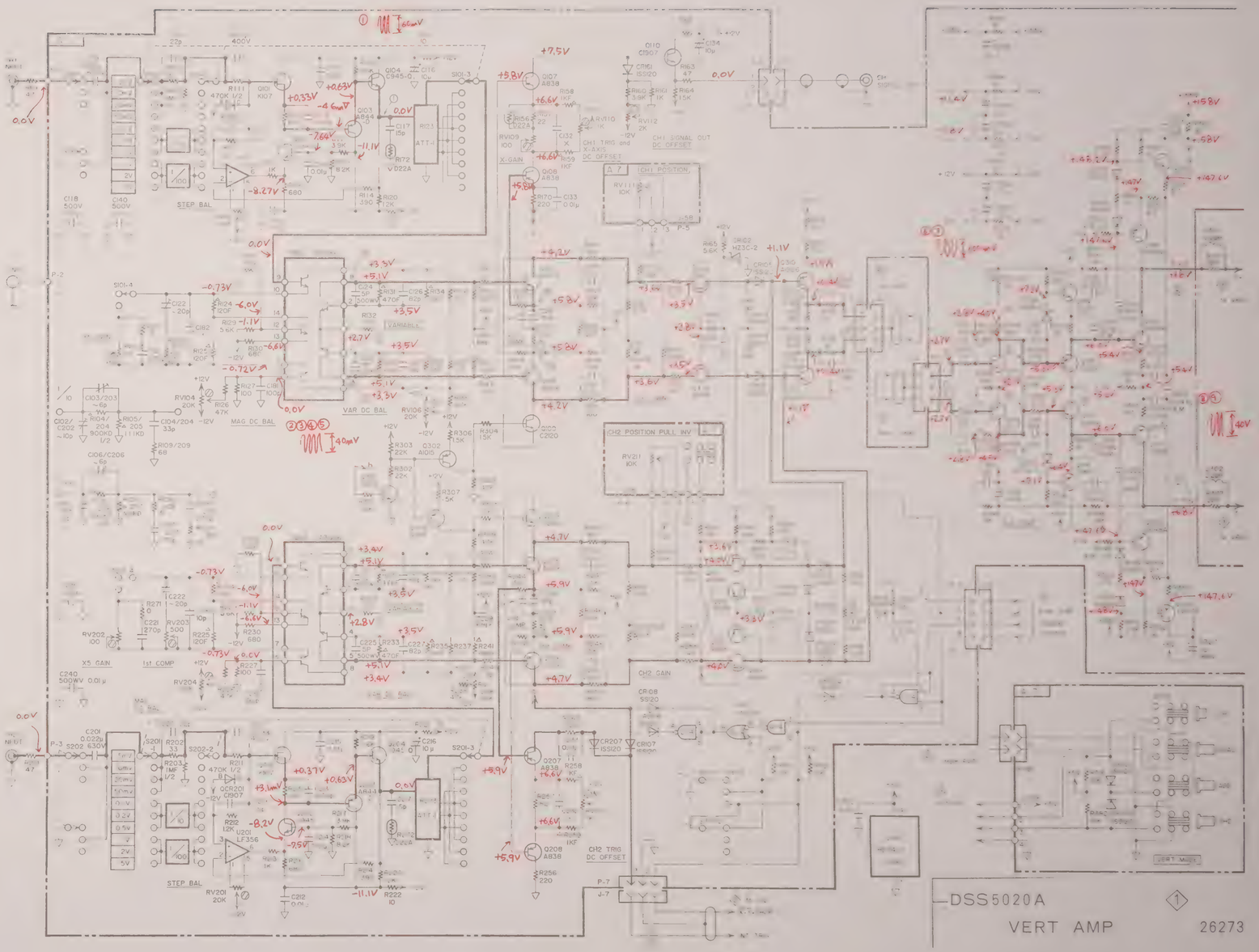
Part	Omitted unit	Omitted functions
Resistor	Ω (ohm)	Unless other noted, resistors are 1/4W carbon film type having an accuracy of ±5%
Capacitor	F (Farad)	The type, accuracy, and rated voltage of capacitors are all different. For details, refer to the parts list.

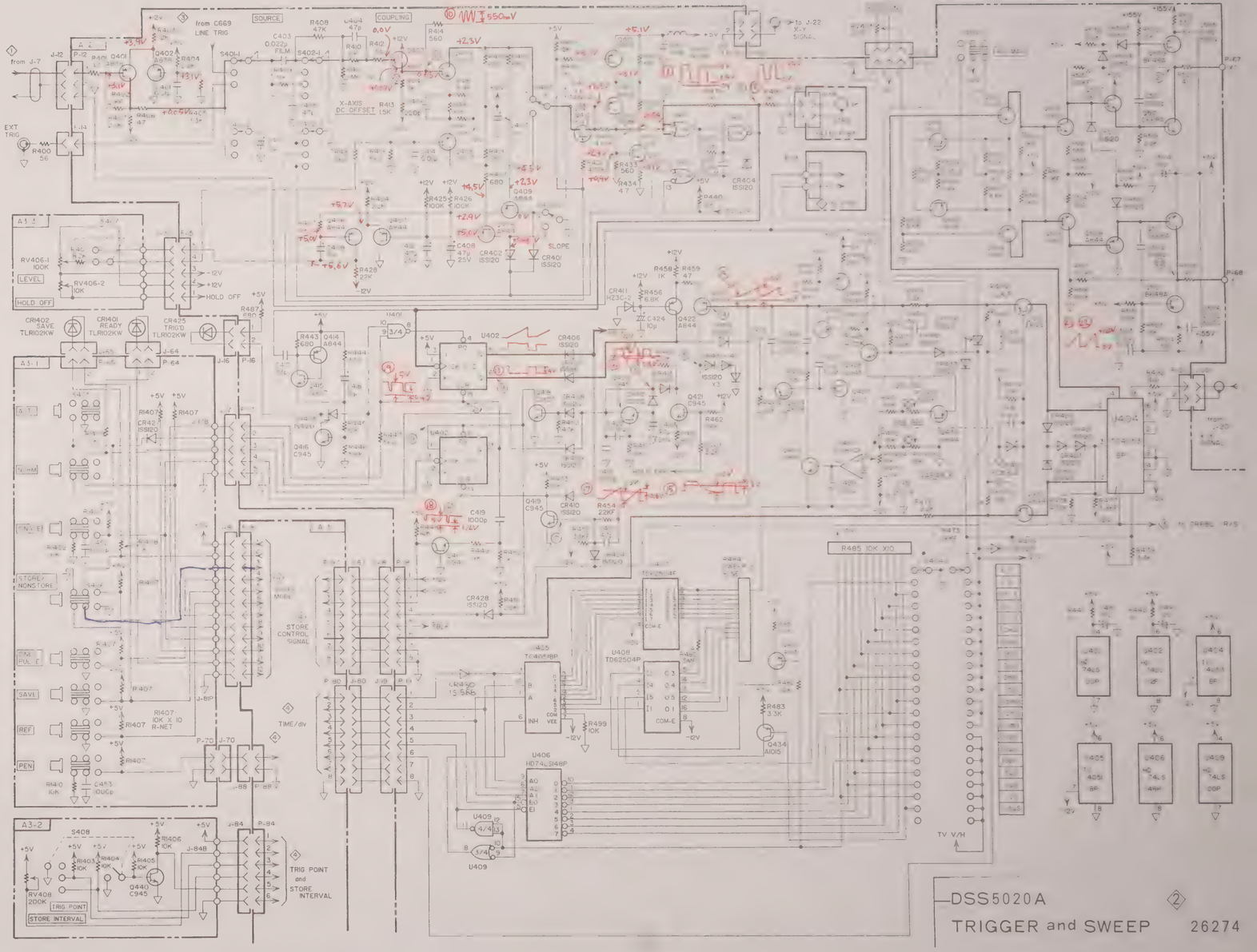
Table 4-13 *Omitted units and function*

Table 4-14 shows special symbols used in the circuit diagrams

Symbol	Content
⚠	Indicates metal film resistor.
※	Indicates parts which may be unavoidably changed for production reasons. Parts indicated are standard parts.
Ø	Indecates semi-fixed resistor.

Table 4-14 *Special symbols and their meanings*




DSS5020A
TRIGGER and SWEEP
26274
SOURCE
COUPLING
X-AXIS DC OFFSET R413 15K
SLOPE
LEVEL
HOLD OFF
STORE/NONSTORE
SAVE
REF
PEN
STORE CONTROL SIGNAL
TIME/div
TRIG POINT and STORE INTERVAL
STORE INTERVAL
TRIG POINT
TV V/H
R485 10K X10
U408 TD62504P
U406 HD74LS148P
U409
U402
U404
U405 TV405-BP
R499 10K
R483 3.3K
Q434 A015
CR428 1S 588
CR406 ISS120
CR410 ISS120
CR411 HZ3C2
CR401 ISS120
CR402 ISS120
CR404 ISS120
CR425 TRIO TLRIO2KW
CR427 ISS120
CR401 READY TLRIO2KW
CR402 SAVE TLRIO2KW
R407 10K X 10 R-NET
RV406-1 100K
RV406-2 10K
RV408 200K
S408
S401-1
S402-1
from J-7
EXT TRIG
R400 56
from C669 LINE TRIG
to J-22 X-Y SIGNAL
HOLD OFF
J-64
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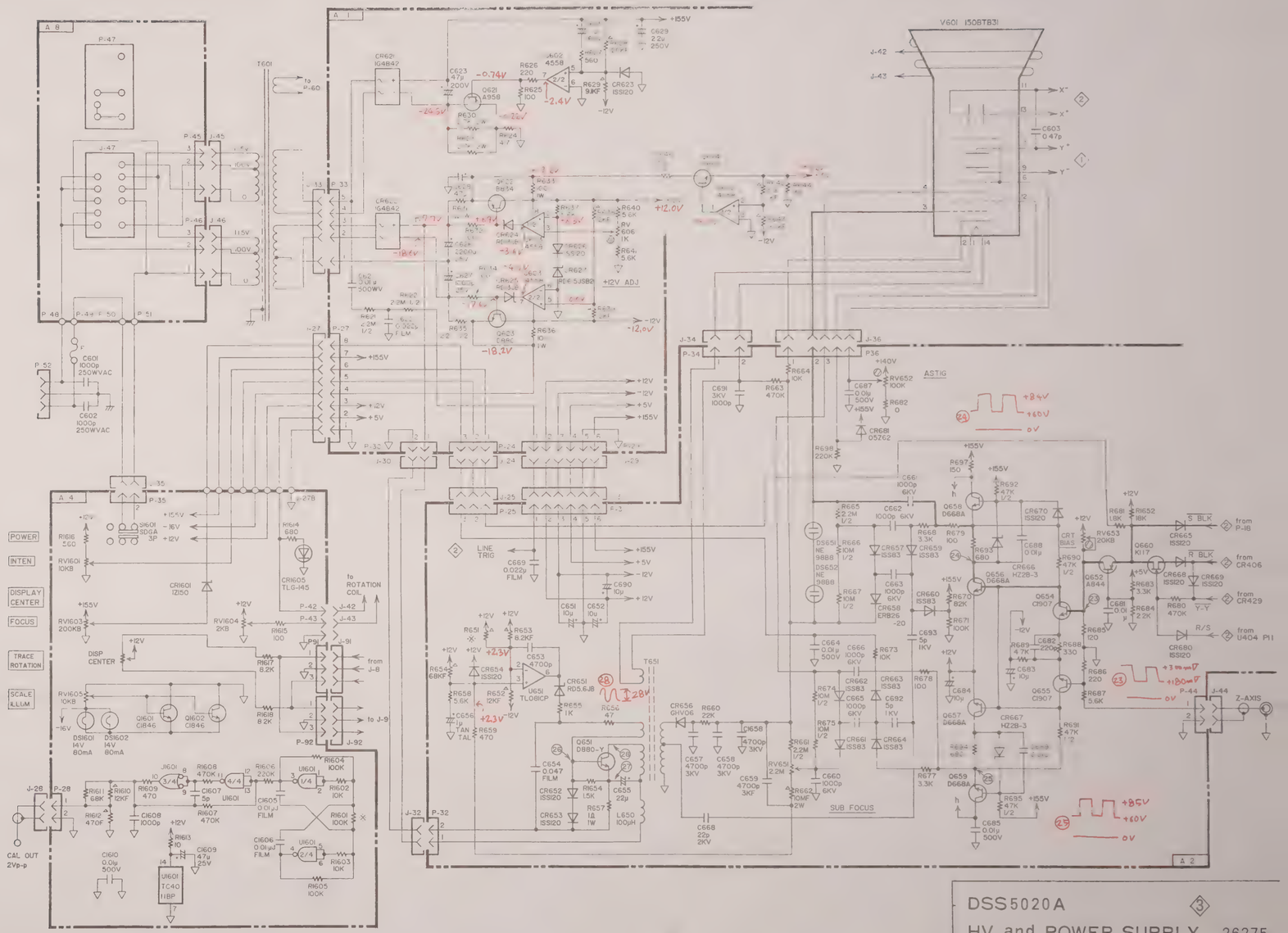
DSS5020A
HV and POWER SUPPLY
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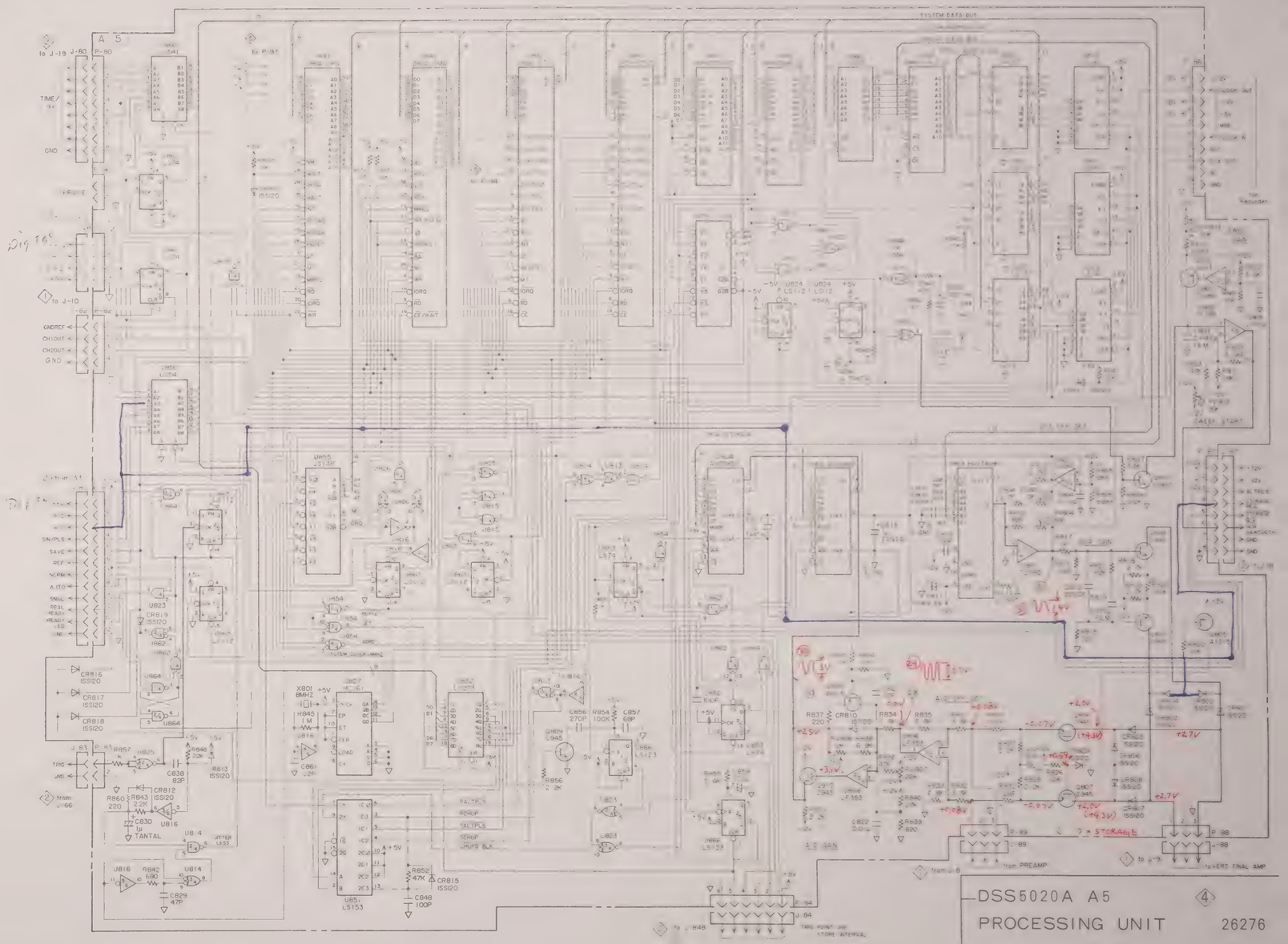
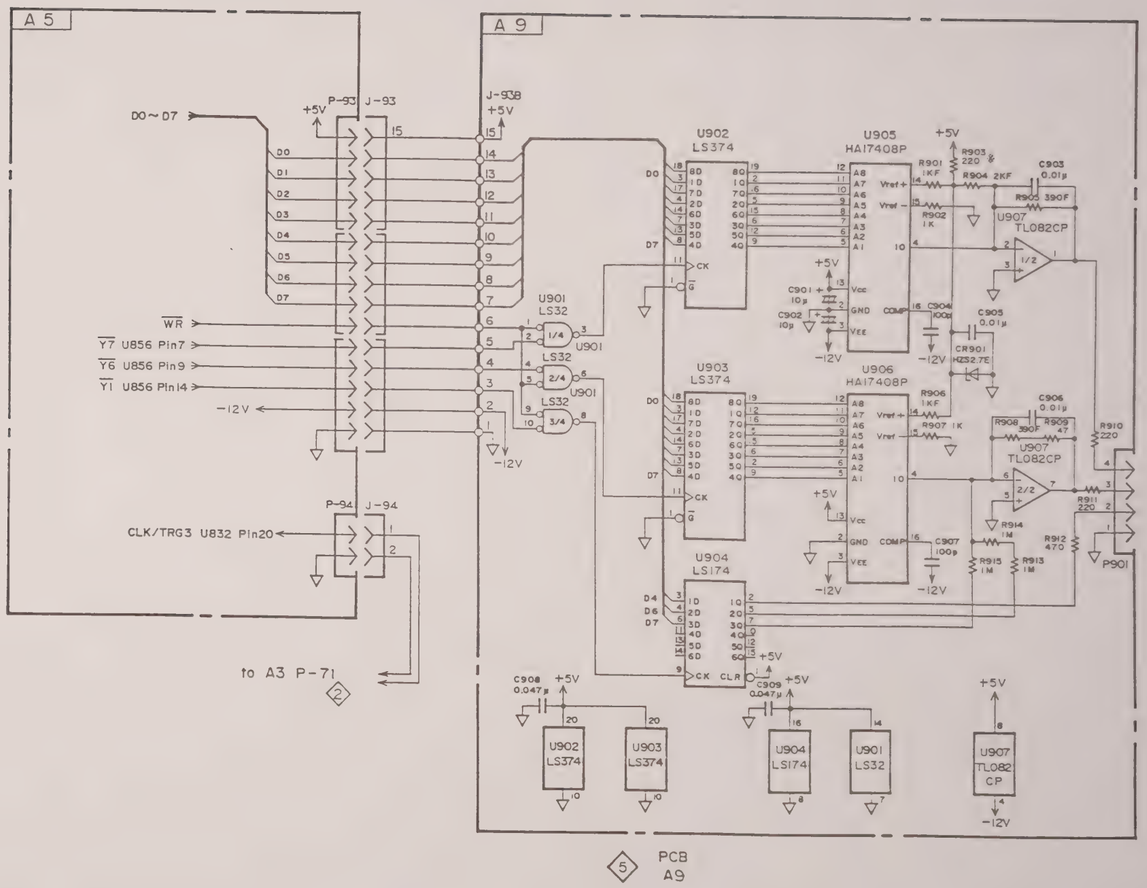
DISPLAY CENTER
FOCUS
TRACE ROTATION
SCALE ILLUM
ASTIG
SUB FOCUS
LINE TRIG
DISP CENTER
to ROTATION COIL
CAL OUT 2Vp-p
Z-AXIS
S BLK
R BLK
R/S
CRT BIAS


A 5
SYSTEM DATA BUS
DSS5020A A5
PROCESSING UNIT
26276



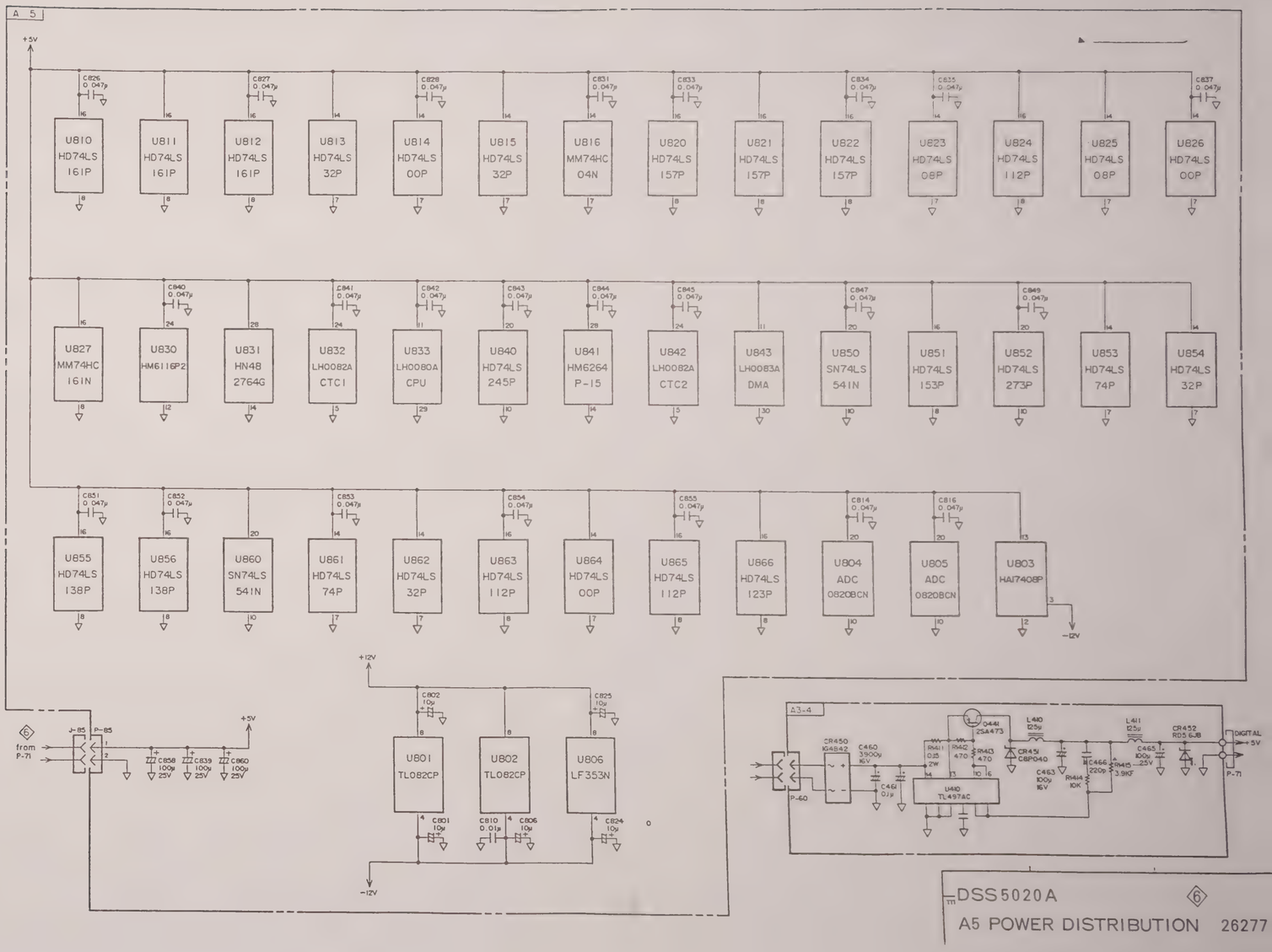
TITLE

DSS5020A
X-Y RECORDER OUT

5

DRAWING NO.

321784



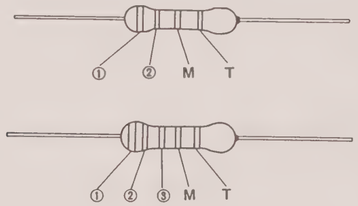
DSS5020A ⑥

A5 POWER DISTRIBUTION 26277

4 .4 .4 Exterior of components

The exterior of electronic components used in this unit, including indications on them, and pin arrangement, is shown below.

1) Indication of resistance value and resistance accuracy.



① ② and ③ – 1st, and 2nd, and 3rd significant figures

M – multiplier

T – tolerance

COLOR	SIGNIFICANT FIGURES	MULTIPLIER	TOLERANCE
BLACK	0	1	–
BROWN	1	10	±1%
RED	2	10^2 or 100	±2%
ORANGE	3	10^3 or 1K	±3%
YELLOW	4	10^4 or 10K	±4%
GREEN	5	10^5 or 100K	±0.5%
BLUE	6	10^6 or 1M	±0.25%
VIOLET	7	–	±0.1%
GRAY	8	–	–
WHITE	9	–	–
GOLD	–	10^{-1} or 0.1	±5%
SILVER	–	10^{-2} or 0.01	±10%
NONE	–	–	±20%

2) Exterior of semiconductors and pin arrangement

TRANSISTOR

2SA838 2SA844 2SC945 2SC1834 2SC1907 2SC2120 | 2SA1206 | 2SC2570 | 2SA958 2SB834 2AD880 | 2SB648 2SC1846 2SD668

FET

2SK107 | 2SK105 2SK117 | 1G4B42

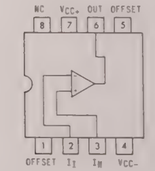
LED

TLR102KW TLG102KW | TLG145

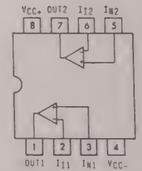
DIODE

1SS83 1S1588 RD5.6JB RD13FB HZ2B-3 HZ3C-2 1Z150

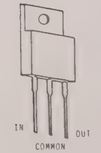
OP AMP



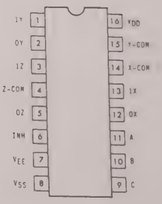
LF13741



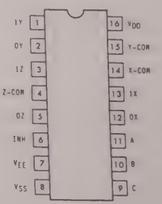
M5218P TL082 LF353



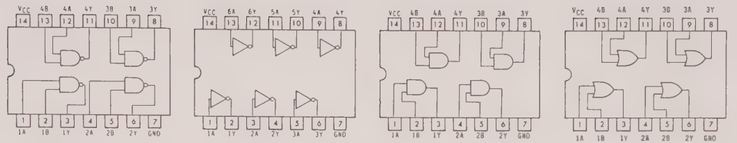
TL78005



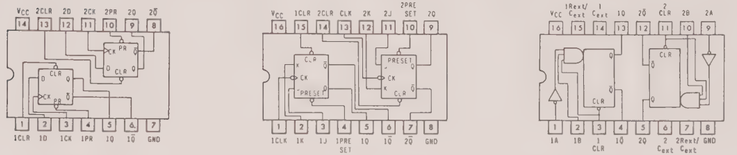
TC4051



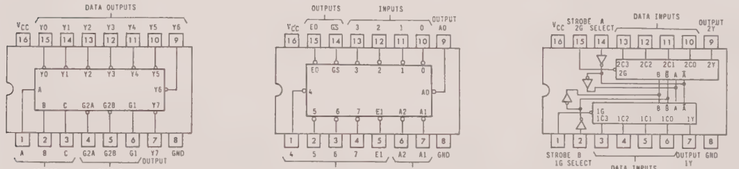
TC4053



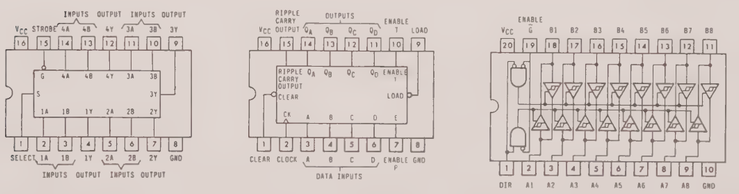
SN74LS00 HD74LS00 | SN74LS04 HD74LS04 MM74HC04 | SN74LS08 HD74LS08 | SN74LS32



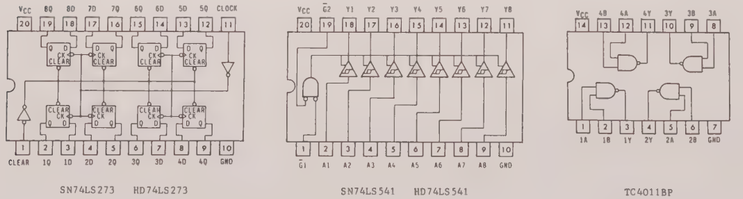
SN74LS74 HD74LS74 | SN74LS112 HD74LS112 | SN74LS123 HD74LS123



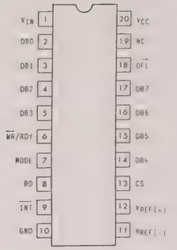
SN74LS138 HD74LS128 | SN74LS148 HD74LS148 | SN74LS153 HD74LS153



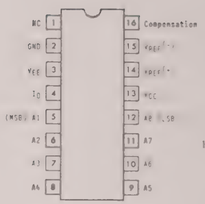
SN74LS157 HD74LS157 | SN74LS161 HD74LS161 | SN74LS245 HD74LS245



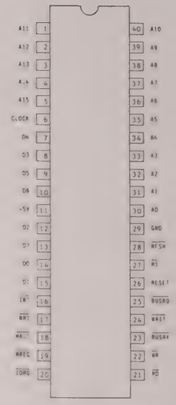
SN74LS273 HD74LS273 | SN74LS541 HD74LS541 | TC4011BP



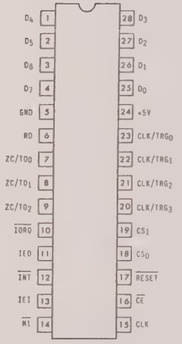
ADC0820



HA1740BP



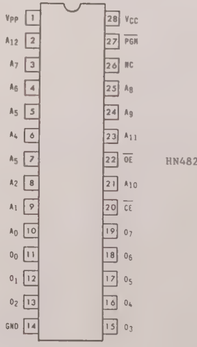
Z80A-CPU



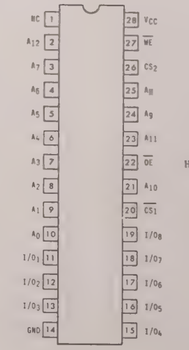
Z80-CTC

Z80-DMA

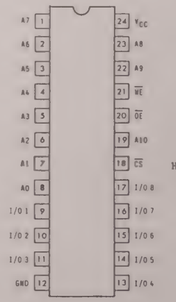
MEMORY



HN482764/G



HM6264P-15



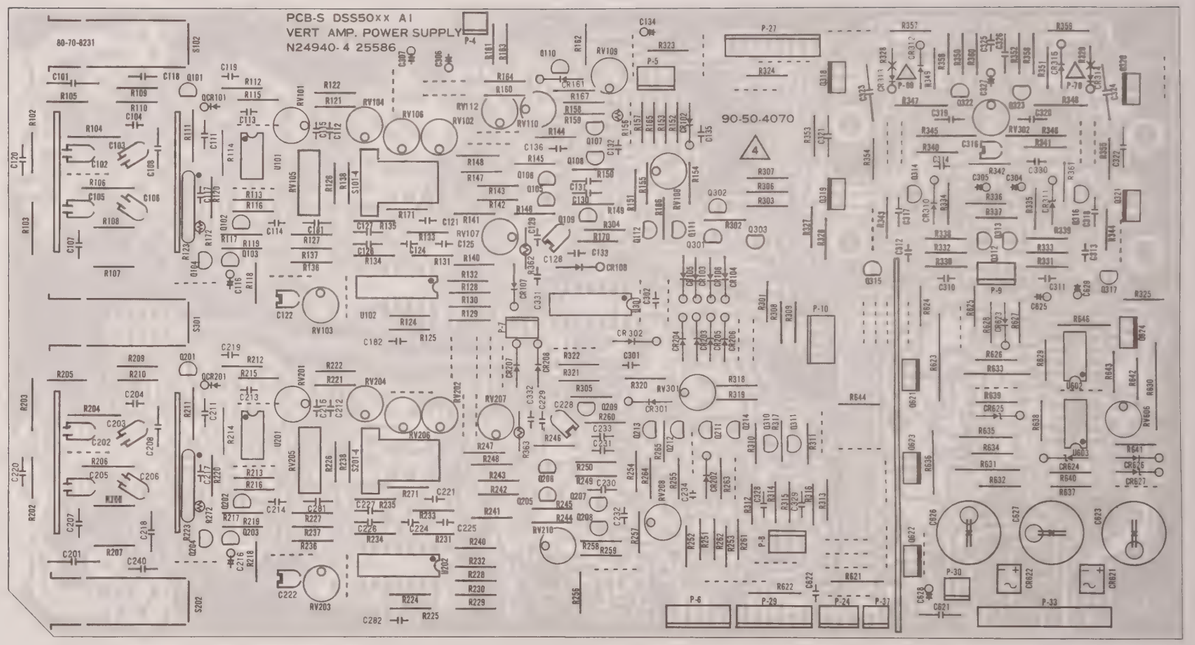
HM6116LP-2

SEMICONDUCTOR LEAD CONFIGURATION

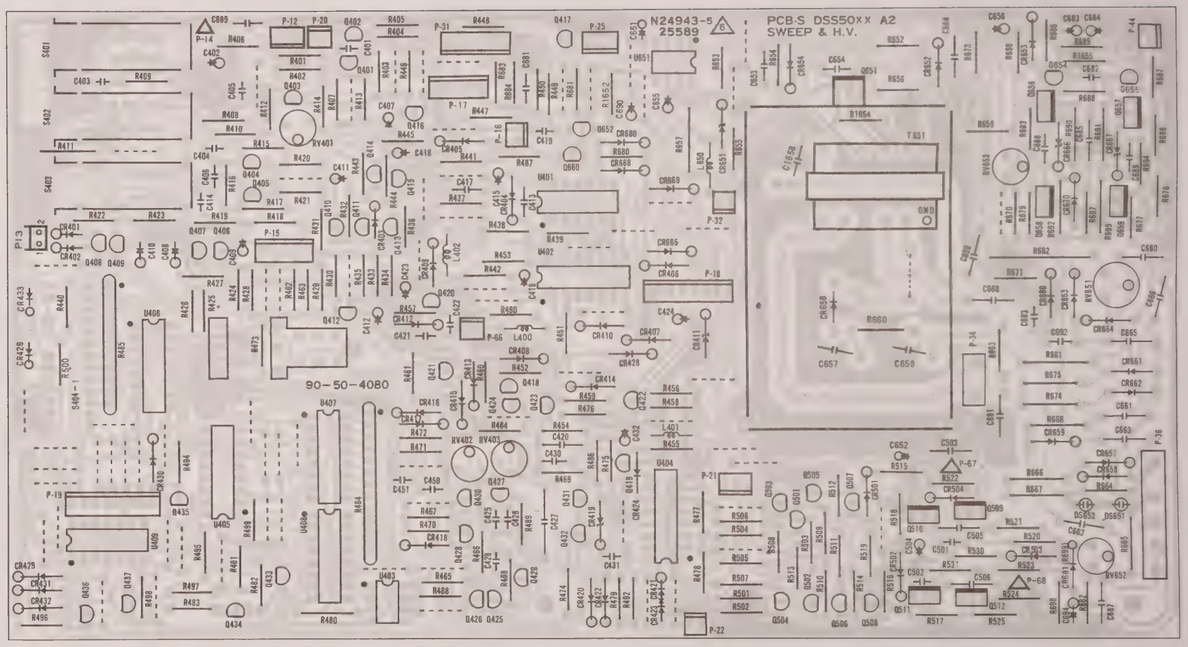
4.4.5 Parts Location

This section describes location of the parts on the boards used in the oscilloscope

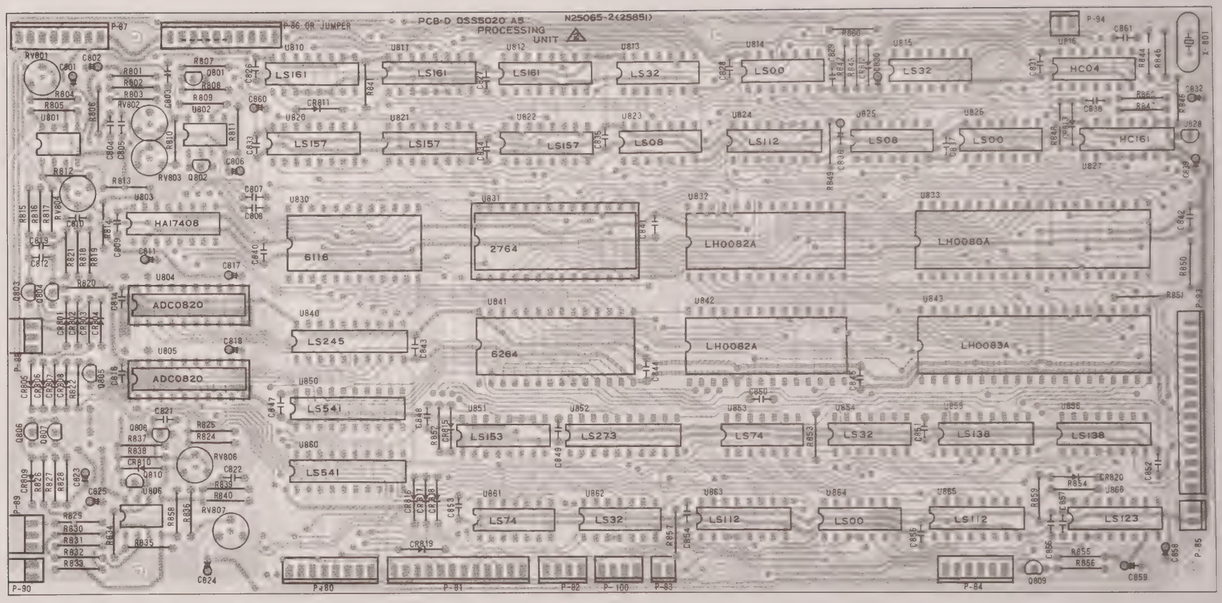
1) A1 VERT AMP & POWER SUPPLY
2) A2 SWEEP & H.V
3) A5 PROCESSING UNIT
4) A5 PROCESSING UNIT
5) A3 STORAGE MODE SWITCH
6) A4 CAL & CRT CONTROL
7) A6 CRT CONNECTOR
8) A7 VERT MODE SWITCH
9) A8 X-Y RECORDER OUT



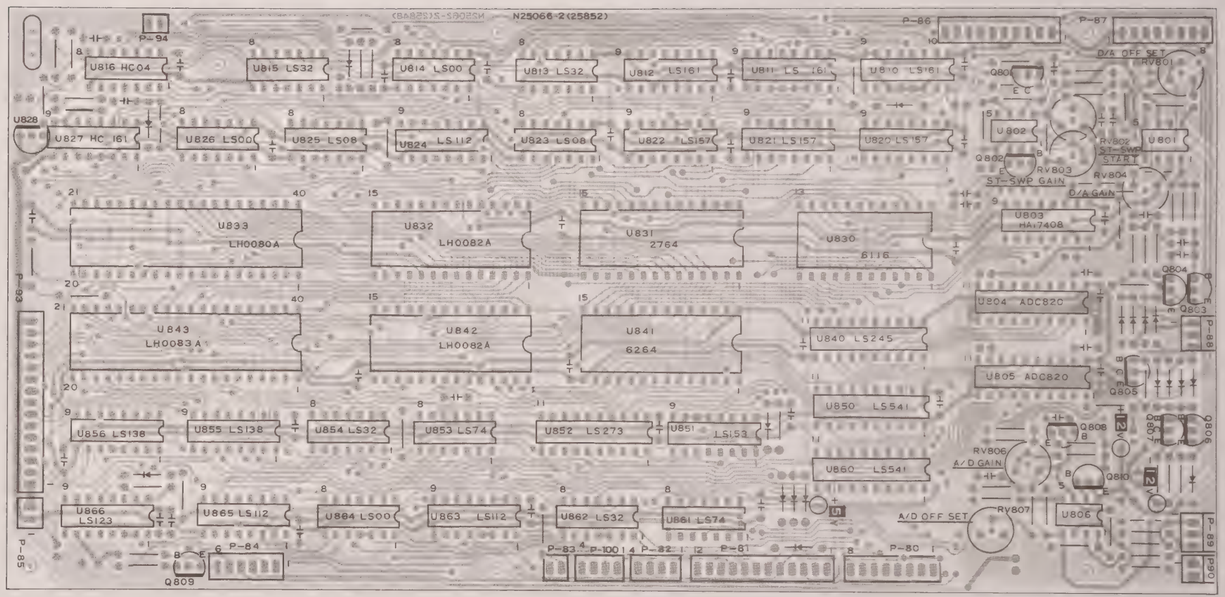
1) A1 VERT AMP & POWER SUPPLY (Parts side view)



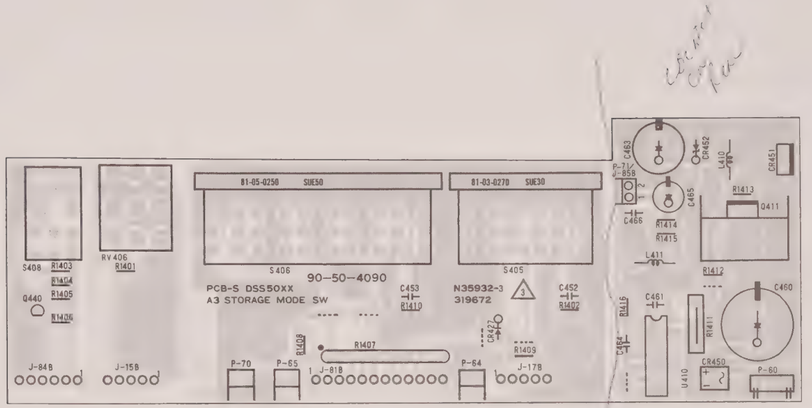
2) A2 SWEEP & H.V (Parts side view)



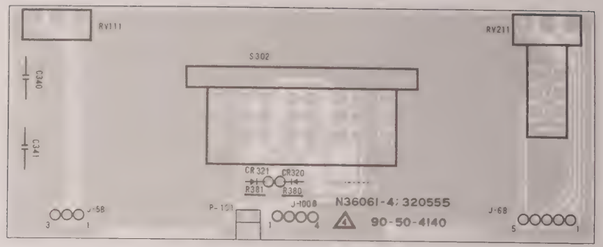
3) A5 PROCESSING UNIT (Parts side view)



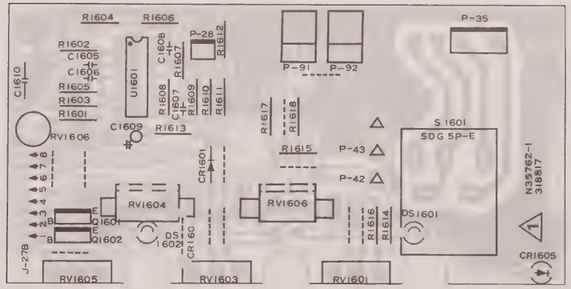
4) A5 PROCESSING UNIT (Circuits side view)



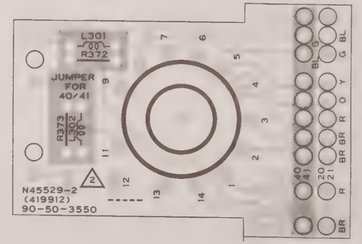
5) A3 STORAGE MODE SWITCH (Parts side view)



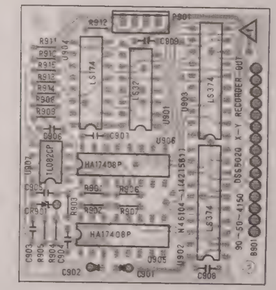
8) A7 VERT MODE SWITCH (Parts side view)



6) A4 CAL & CRT CONTROL (Parts side view)



7) A6 CRT CONNECTOR
(Parts side view)



4.4.6 Electrical Parts List

The parts used in this Instrument are listed in units of assemblies.

Table 4-15 lists the assemblies and their contents.

Assembly Name	Contents
A ASSEMBLY	Parts mounted on A6 board. (CRT CONNECTOR)
B ASSEMBLY	Parts not mounted on PC board.
A1 ASSEMBLY	Parts mounted on A1 board. (VERT AMP & POWER SUPPLY)
A2 ASSEMBLY	Parts mounted on A2 board. (SWEEP & H.V)
A3 ASSEMBLY	Parts mounted on A3 board. (STORAGE MODE SWITCH)
A4 ASSEMBLY	Parts mounted on A4 board. (CAL & CRT CONTROL)
A5 ASSEMBLY	Parts mounted on A5 board. (PROCESSING UNIT)
A7 ASSEMBLY	Parts mounted on A7 board. (VERT MODE SWITCH)
A8 ASSEMBLY	Parts mounted on A8 board. (X-Y RECORDER OUT)

Table 4-15 Assemblies

Mnemonic symbols are used for the explanation of parts. Table 4-16 lists the Mnemonic symbols.

Mnemonic symbol	Meaning
CER	CERAMIC
C FILM	CARBON FILM
C COMP	CARBON COMPOSITION
CRT	CATHODE RAY TUBE
ELECT	ELECTROLYTIC
FET	FIELD EFFECT TRANSISTOR
FXD	FIXED
LED	LIGHT EMITTING DIODE
M FILM	METAL FILM
M GLAZE	METAL GLAZE
M OX	METAL OXIDE
M PLSTC FILM	METALLIZED PLASTIC FILM
SI	SILICON
TANT ELECT	TANTALUM ELECTROLYTIC
VAR	VARIABLE
WW	WIRE WOUND
*	OPTIMUM VALUE SELECTED AT FACTRY AVERAGE VALUE SHOWN.(PART MAY BE OMITTED)

Table 4-16 Mnemonic symbols

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A
A ASSEMBLY			
C603	52-96-1140	FXD COMP 0.68PF 10% 500V	
L301	67-10-0880	INDUCTOR 2.2UH 20%	
L302	67-10-0880	INDUCTOR 2.2UH 20%	
R372	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R373	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
B ASSEMBLY			
C601	52-77-1010	FXD CER 1000PF 250VAC	FOR UL & CSA
C602	52-77-1010	FXD CER 1000PF 250VAC	FOR UL & CSA
CR425	37-00-0092	LAMP LED RED	TOSHIBA TLR102KW
CR1401	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR1402	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
R101	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	NAS1/4S
R201	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	NAS1/4S
R400	40-27-0562	FXD C FILM 56 OHM 5% 1/4W	NAS1/4S
RV405	45-35-3107	VAR C COMP 10K OHM	V16L4N15KC
T601	60-45-0120	PT	S8310253
V601	21-16-0602	CATHODE RAY TUBE	TOSHIBA 150BTB31
A1 ASSEMBLY			
C101	50-96-3590	FXD PLSTC FILM 0.022MF 20% 630WV	
C102	57-10-1191	VAR CER 3-10PF	
C103	57-10-1181	VAR CER 3-6PF	
C104	52-06-2165	FXD CER 33PF 10% 500V TYPE1	
C105	57-10-1191	VAR CER 3-10PF	
C106	57-10-1181	VAR CER 3-6PF	
C107	52-06-2274	FXD CER 270P 10% 50V TYPE1	
C108	52-06-2274	FXD CER 270P 10% 50V TYPE1	
C111	50-87-0510	FXD PLSTC FILM 2200PF 20% 400WV	
C112	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C113	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C114	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C115	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C116	54-40-1200	FXD ELECT 10MF 50WV	
C117	52-06-2125	FXD CER 15PF 10% 500V TYPE1	
C118	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C119	52-06-2051	FXD CER 5P 10% 50V TYPE1	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A
C120	52-06-2145	FXD CER 22PF 10% 500V TYPE1
C121	52-06-2245	FXD CER 150PF 10% 50V TYPE1
C122	57-10-1203	VAR CER 5-20PF
C123	52-06-2102	FXD CER 10P 10% 50V TYPE1
C124	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C125	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C126	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C127	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C128	57-10-1223	VAR CER 8-50PF
C129	52-06-2204	FXD CER 68P 10% 50V TYPE1
C130	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C131	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C133	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C134	54-40-1200	FXD ELECT 10MF 50WV
C135	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C140	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C181	52-06-2225	FXD CER 100PF 10% 50V TYPE1
C201	50-96-3590	FXD PLSTC FILM 0.022MF 20% 630WV
C202	57-10-1191	VAR CER 3-10PF
C203	57-10-1181	VAR CER 3-6PF
C204	52-06-2165	FXD CER 33PF 10% 500V TYPE1
C205	57-10-1191	VAR CER 3-10PF
C206	57-10-1181	VAR CER 3-6PF
C207	52-06-2274	FXD CER 270P 10% 50V TYPE1
C208	52-06-2274	FXD CER 270P 10% 50V TYPE1
C211	50-87-0510	FXD PLSTC FILM 2200PF 20% 400WV
C212	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C213	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C214	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C215	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C216	54-40-1200	FXD ELECT 10MF 50WV
C217	52-06-2125	FXD CER 15PF 10% 500V TYPE1
C218	52-06-2265	FXD CER 220PF 10% 50V TYPE1
C219	52-06-2051	FXD CER 5P 10% 50V TYPE1
C220	52-06-2145	FXD CER 22PF 10% 500V TYPE1
C221	52-06-2245	FXD CER 150PF 10% 50V TYPE1
C222	57-10-1203	VAR CER 5-20PF
C223	52-06-2051	FXD CER 5P 10% 50V TYPE1
C224	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C225	52-06-3051	FXD CER 5PF 10% 500V TYPE1
C226	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C227	52-06-2215	FXD CER 82PF 10% 500V TYPE1
C228	57-10-1223	VAR CER 8-50PF
C229	52-06-2204	FXD CER 68P 10% 50V TYPE1
C230	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C231	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C233	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C234	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C240	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C281	52-06-2225	FXD CER 100PF 10% 50V TYPE1
C282	52-06-2102	FXD CER 10P 10% 50V TYPE1
C301	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C302	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C304	54-40-1200	FXD ELECT 10MF 50WV

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
C305	54-40-1200	FXD ELECT 10MF 50WV		
C306	54-30-1970	FXD ELECT 100MF 25WV		
C307	54-30-1970	FXD ELECT 100MF 25WV		
C311	52-06-2184	FXD CER 47PF 10% 50V TYPE1		
C312	52-06-2155	FXD CER 27P 10% 50V TYPE1		
C313	52-06-2155	FXD CER 27P 10% 50V TYPE1		
C314	52-06-2051	FXD CER 5P 10% 50V TYPE1		
C316	57-10-1203	VAR CER 5-20PF		
C317	50-67-0030	FXD PLSTC FILM 0.01MF 10% 100WV		
C318	50-67-0030	FXD PLSTC FILM 0.01MF 10% 100WV		
C319	52-96-1140	FXD COMP 0.68PF 10% 500V		
C320	52-96-1140	FXD COMP 0.68PF 10% 500V		
C321	50-77-3500	FXD PLSTC FILM 0.047MF 20% 250WV		
C322	50-77-3500	FXD PLSTC FILM 0.047MF 20% 250WV		
C323	50-96-3590	FXD PLSTC FILM 0.022MF 20% 630WV		
C324	50-96-3590	FXD PLSTC FILM 0.022MF 20% 630WV		
C325	50-67-0050	FXD PLSTC FILM 0.047MF 10% 100WV		
C326	52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2		
C327	54-60-1740	FXD ELECT 1MF 160WV		
C621	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2		
C622	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100WV		
C623	54-60-1730	FXD ELECT 47MF 200WV		
C625	54-60-1740	FXD ELECT 1MF 160WV		
C626	54-30-1840	FXD ELECT 2200MF 25WV		
C627	54-30-1830	FXD ELECT 1000MF 25WV		
C628	54-30-1960	FXD ELECT 47MF 25WV		
C629	54-70-1080	FXD ELECT 2.2MF 250WV		
CR102	32-92-0033	ZENER VZ=3.2 - 3.4V	HITACHI	HZ3C-2
CR103	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR104	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR105	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR106	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR107	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR108	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR161	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR202	32-92-0033	ZENER VZ=3.2 - 3.4V	HITACHI	HZ3C-2
CR203	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR204	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR205	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR206	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR207	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR208	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR301	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR302	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR310	32-92-0022	ZENER VZ=2.1 - 2.3V	HITACHI	HZ2B-3
CR311	32-92-0022	ZENER VZ=2.1 - 2.3V	HITACHI	HZ2B-3
CR312	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR313	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR314	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR315	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR621	32-90-2110	DIODE BRIGE VRM=400V IO=1A	TOSHIBA	1G4B42
CR622	32-90-2110	DIODE BRIGE VRM=400V IO=1A	TOSHIBA	1G4B42
CR623	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
CR624	32-92-0130	ZENER VZ=12.4-13.1V P=0.4W	NEC	RD13JB1
CR625	32-92-0130	ZENER VZ=12.4-13.1V P=0.4W	NEC	RD13JB1
CR626	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR627	32-92-0056	ZENER VZ=5.5 - 5.8V P=0.4W	NEC	RD5.6JB2
Q101	31-20-1073	FET IDSS=4.5-7.7MA	SONY	2SK107-3
Q102	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q103	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q104	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q105	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q106	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q107	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q108	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q109	30-32-1201	TR SI NPN	TOSHIBA	2SC2120-Y
Q110	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q111	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q112	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q201	31-20-1073	FET IDSS=4.5-7.7MA	SONY	2SK107-3
Q202	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q203	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q204	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q205	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q206	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q207	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q208	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q209	30-32-1201	TR SI NPN	TOSHIBA	2SC2120-Y
Q211	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q212	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q213	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q214	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q301	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q302	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q303	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q310	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q311	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q312	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q313	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q314	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q315	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q316	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q317	30-11-2061	TR SI PNP	NEC	2SA1206-L
Q318	30-20-6481	TR SI PNP	HITACHI	2SB648A
Q319	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q320	30-20-6481	TR SI PNP	HITACHI	2SB648A
Q321	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q322	30-32-5700	TR SI NPN	NEC	2SC2570
Q323	30-32-5700	TR SI NPN	NEC	2SC2570
Q621	30-10-9580	TR SI PNP	KIKUSUI	S8309591
Q622	30-20-8341	TR SI PNP	TOSHIBA	2SB834-Y
Q623	30-40-8802	TR SI NPN	TOSHIBA	2SD880-Y
Q624	30-40-8802	TR SI NPN	TOSHIBA	2SD880-Y
QCR101	30-31-9071	TR SI NPN	HITACHI	2SC1907
QCR201	30-31-9071	TR SI NPN	HITACHI	2SC1907

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A		
R102	40-27-0332	FXD C FILM	33 OHM 5% 1/4W		NAS1/4S
R103	42-33-0420	FXD M FILM	1M OHM 1% 1/2W		RN1/2S
R104	42-33-0390	FXD M FILM	900K OHM .5% 1/2W		RN1/2S
R105	42-82-4111	FXD M FILM	111K OHM .5% 1/4W		RN1/4S
R106	42-33-0400	FXD M FILM	990K OHM .5% 1/2W		RN1/2S
R107	42-82-3101	FXD M FILM	10.1K OHM .5% 1/4W		RN1/4S
R108	40-27-0152	FXD C FILM	15 OHM 5% 1/4W		NAS1/4S
R109	40-27-0682	FXD C FILM	68 OHM 5% 1/4W		NAS1/4S
R110	40-27-0152	FXD C FILM	15 OHM 5% 1/4W		NAS1/4S
R111	40-37-4471	FXD C FILM	470K OHM 5% 1/2W		
R112	40-27-2122	FXD C FILM	1.2K OHM 5% 1/4W		
R113	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R114	40-27-1392	FXD C FILM	390 OHM 5% 1/4W		
R115	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R116	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R117	40-27-2392	FXD C FILM	3.9K OHM 5% 1/4W		
R118	40-27-2822	FXD C FILM	8.2K OHM 5% 1/4W		
R119	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R120	40-27-2122	FXD C FILM	1.2K OHM 5% 1/4W		
R121	40-27-0102	FXD C FILM	10 OHM 5% 1/4W		NAS1/4S
R122	40-27-0102	FXD C FILM	10 OHM 5% 1/4W		NAS1/4S
R123	44-04-0000	FXD M GLAZE	R-NETWORK	KIKUSUI	S8109001
R124	42-83-1120	FXD M FILM	120 OHM 1% 1/4W		
R125	42-83-1120	FXD M FILM	120 OHM 1% 1/4W		
R126	40-27-3472	FXD C FILM	47K OHM 5% 1/4W		
R127	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R128	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R129	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R130	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R131	42-83-1470	FXD M FILM	470 OHM 1% 1/4W		
R132	40-27-1272	FXD C FILM	270 OHM 5% 1/4W		
R133	42-83-1470	FXD M FILM	470 OHM 1% 1/4W		
R134	42-83-0560	FXD M FILM	56 OHM 1% 1/4W		
R135	42-83-0560	FXD M FILM	56 OHM 1% 1/4W		
R136	40-27-0272	FXD C FILM	27 OHM 5% 1/4W		NAS1/4S
R137	40-27-0272	FXD C FILM	27 OHM 5% 1/4W		NAS1/4S
R138	40-27-3472	FXD C FILM	47K OHM 5% 1/4W		
R140	42-83-1680	FXD M FILM	680 OHM 1% 1/4W		
R141	42-83-1680	FXD M FILM	680 OHM 1% 1/4W		
R142	40-27-0222	FXD C FILM	22 OHM 5% 1/4W		NAS1/4S
R143	40-27-0222	FXD C FILM	22 OHM 5% 1/4W		NAS1/4S
R144	40-27-1152	FXD C FILM	150 OHM 5% 1/4W		
R145	40-27-1152	FXD C FILM	150 OHM 5% 1/4W		
R146	42-83-1100	FXD M FILM	100 OHM 1% 1/4W		
R147	40-27-2152	FXD C FILM	1.5K OHM 5% 1/4W		
R148	40-27-2152	FXD C FILM	1.5K OHM 5% 1/4W		
R149	40-27-1182	FXD C FILM	180 OHM 5% 1/4W		
R150	40-27-1182	FXD C FILM	180 OHM 5% 1/4W		
R151	40-27-1272	FXD C FILM	270 OHM 5% 1/4W		
R152	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R153	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R154	40-27-0472	FXD C FILM	47 OHM 5% 1/4W		NAS1/4S
R155	40-27-0472	FXD C FILM	47 OHM 5% 1/4W		NAS1/4S
R156	38-00-0070	THERMISTOR	200 OHM	TOSHIBA	D22A

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A		
R157	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R158	42-83-2100	FXD M FILM 1K OHM 1% 1/4W			
R159	42-83-2100	FXD M FILM 1K OHM 1% 1/4W			
R160	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W			
R161	40-27-2102	FXD C FILM 1K OHM 5% 1/4W			
R162	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R163	40-27-0472	FXD C FILM 47 OHM 5% 1/4W			NAS1/4S
R164	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R165	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R166	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R170	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R171	40-27-0000	JUMPER PARTS			NAS1/4
R172	38-00-0070	THERMISTOR 200 OHM		TOSHIBA	D22A
R202	40-27-0332	FXD C FILM 33 OHM 5% 1/4W			NAS1/4S
R203	42-33-0420	FXD M FILM 1M OHM 1% 1/2W			RN1/2S
R204	42-33-0390	FXD M FILM 900K OHM .5% 1/2W			RN1/2S
R205	42-82-4111	FXD M FILM 111K OHM .5% 1/4W			RN1/4S
R206	42-33-0400	FXD M FILM 990K OHM .5% 1/2W			RN1/2S
R207	42-82-3101	FXD M FILM 10.1K OHM .5% 1/4W			RN1/4S
R208	40-27-0152	FXD C FILM 15 OHM 5% 1/4W			NAS1/4S
R209	40-27-0682	FXD C FILM 68 OHM 5% 1/4W			NAS1/4S
R210	40-27-0152	FXD C FILM 15 OHM 5% 1/4W			NAS1/4S
R211	40-37-4471	FXD C FILM 470K OHM 5% 1/2W			
R212	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W			
R213	40-27-2102	FXD C FILM 1K OHM 5% 1/4W			
R214	40-27-1392	FXD C FILM 390 OHM 5% 1/4W			
R215	40-27-1102	FXD C FILM 100 OHM 5% 1/4W			NAS1/4S
R216	40-27-1682	FXD C FILM 680 OHM 5% 1/4W			
R217	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W			
R218	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W			
R219	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R220	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W			
R221	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R222	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R223	44-04-0000	FXD M GLAZE R-NETWORK		KIKUSUI	S8109001
R224	42-83-1120	FXD M FILM 120 OHM 1% 1/4W			
R225	42-83-1120	FXD M FILM 120 OHM 1% 1/4W			
R226	40-27-3472	FXD C FILM 47K OHM 5% 1/4W			
R227	40-27-1102	FXD C FILM 100 OHM 5% 1/4W			NAS1/4S
R228	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R229	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R230	40-27-1682	FXD C FILM 680 OHM 5% 1/4W			
R231	42-83-1470	FXD M FILM 470 OHM 1% 1/4W			
R232	40-27-1272	FXD C FILM 270 OHM 5% 1/4W			
R233	42-83-1470	FXD M FILM 470 OHM 1% 1/4W			
R234	42-83-0560	FXD M FILM 56 OHM 1% 1/4W			
R235	42-83-0560	FXD M FILM 56 OHM 1% 1/4W			
R236	40-27-0272	FXD C FILM 27 OHM 5% 1/4W			NAS1/4S
R237	40-27-0272	FXD C FILM 27 OHM 5% 1/4W			NAS1/4S
R238	40-27-3472	FXD C FILM 47K OHM 5% 1/4W			
R240	42-83-1680	FXD M FILM 680 OHM 1% 1/4W			
R241	42-83-1680	FXD M FILM 680 OHM 1% 1/4W			
R242	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R243	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A		
R244	40-27-1152	FXD C FILM 150 OHM 5% 1/4W			
R245	40-27-1152	FXD C FILM 150 OHM 5% 1/4W			
R246	42-83-1100	FXD M FILM 100 OHM 1% 1/4W			
R247	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R248	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R249	40-27-1182	FXD C FILM 180 OHM 5% 1/4W			
R250	40-27-1182	FXD C FILM 180 OHM 5% 1/4W			
R251	40-27-1272	FXD C FILM 270 OHM 5% 1/4W			
R252	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R253	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W			
R254	40-27-0472	FXD C FILM 47 OHM 5% 1/4W			NAS1/4S
R255	40-27-0472	FXD C FILM 47 OHM 5% 1/4W			NAS1/4S
R256	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R257	40-27-0822	FXD C FILM 82 OHM 5% 1/4W			NAS1/4S
R258	42-83-2100	FXD M FILM 1K OHM 1% 1/4W			
R259	42-83-2100	FXD M FILM 1K OHM 1% 1/4W			
R260	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R261	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W			
R262	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W			
R263	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R264	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W			
R265	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R271	40-27-0000	JUMPER PARTS			NAS1/4
R272	38-00-0070	THERMISTOR 200 OHM		TOSHIBA	D22A
R301	40-27-3102	FXD C FILM 10K OHM 5% 1/4W			
R302	40-27-3222	FXD C FILM 22K OHM 5% 1/4W			
R303	40-27-3222	FXD C FILM 22K OHM 5% 1/4W			
R304	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R305	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R306	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R307	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W			
R308	40-27-3472	FXD C FILM 47K OHM 5% 1/4W			
R309	40-27-3472	FXD C FILM 47K OHM 5% 1/4W			
R310	42-83-1470	FXD M FILM 470 OHM 1% 1/4W			
R311	42-83-1470	FXD M FILM 470 OHM 1% 1/4W			
R312	40-27-1822	FXD C FILM 820 OHM 5% 1/4W			
R313	40-27-1822	FXD C FILM 820 OHM 5% 1/4W			
R314	40-27-0562	FXD C FILM 56 OHM 5% 1/4W			NAS1/4S
R315	40-27-0562	FXD C FILM 56 OHM 5% 1/4W			NAS1/4S
R316	40-27-0332	FXD C FILM 33 OHM 5% 1/4W			NAS1/4S
R317	40-27-1332	FXD C FILM 330 OHM 5% 1/4W			
R318	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R319	40-27-1222	FXD C FILM 220 OHM 5% 1/4W			
R320	40-27-3102	FXD C FILM 10K OHM 5% 1/4W			
R321	40-27-3102	FXD C FILM 10K OHM 5% 1/4W			
R322	40-27-3102	FXD C FILM 10K OHM 5% 1/4W			
R323	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R324	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R325	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R326	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R327	40-27-0102	FXD C FILM 10 OHM 5% 1/4W			NAS1/4S
R328	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R329	40-27-0222	FXD C FILM 22 OHM 5% 1/4W			NAS1/4S
R330	40-27-0332	FXD C FILM 33 OHM 5% 1/4W			NAS1/4S

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A		
R331	40-27-0332	FXD C FILM	33 OHM 5% 1/4W		NAS1/4S
R332	42-83-1470	FXD M FILM	470 OHM 1% 1/4W		
R333	42-83-1470	FXD M FILM	470 OHM 1% 1/4W		
R334	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R335	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R336	40-27-1822	FXD C FILM	820 OHM 5% 1/4W		
R337	40-27-2152	FXD C FILM	1.5K OHM 5% 1/4W		
R338	40-27-1472	FXD C FILM	470 OHM 5% 1/4W		
R339	40-27-1472	FXD C FILM	470 OHM 5% 1/4W		
R340	40-27-1222	FXD C FILM	220 OHM 5% 1/4W		
R341	40-27-1222	FXD C FILM	220 OHM 5% 1/4W		
R342	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R343	40-27-0222	FXD C FILM	22 OHM 5% 1/4W		NAS1/4S
R344	40-27-0222	FXD C FILM	22 OHM 5% 1/4W		NAS1/4S
R345	44-91-3330	FXD M OXIDE	33K OHM 5% 1W		
R346	44-91-3330	FXD M OXIDE	33K OHM 5% 1W		
R347	40-37-3471	FXD C FILM	47K OHM 5% 1/2W		
R348	40-37-3471	FXD C FILM	47K OHM 5% 1/2W		
R349	40-27-2332	FXD C FILM	3.3K OHM 5% 1/4W		
R350	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R351	40-27-2332	FXD C FILM	3.3K OHM 5% 1/4W		
R352	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R353	40-27-0102	FXD C FILM	10 OHM 5% 1/4W		NAS1/4S
R354	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R355	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R356	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R357	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R358	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R359	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R360	40-27-0822	FXD C FILM	82 OHM 5% 1/4W		NAS1/4S
R621	40-37-5221	FXD C FILM	2.2M OHM 5% 1/2W		
R622	40-37-5221	FXD C FILM	2.2M OHM 5% 1/2W		
R623	44-92-2270	FXD M OXIDE	2.7K OHM 5% 2W		
R624	40-27-8472	FXD C FILM	4.7 OHM 5% 1/4W		
R625	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R626	40-27-1222	FXD C FILM	220 OHM 5% 1/4W		
R627	40-27-1562	FXD C FILM	560 OHM 5% 1/4W		
R628	42-83-4120	FXD M FILM	120K OHM 1% 1/4W		
R629	42-83-2910	FXD M FILM	9.1K OHM 1% 1/4W		
R630	44-92-2270	FXD M OXIDE	2.7K OHM 5% 2W		
R631	44-91-8101	FXD M OXIDE	1 OHM 5% 1W	MATSUSITA	ERX1ANJ
R632	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R633	44-91-1100	FXD M OXIDE	100 OHM 5% 1W	HOKURIKU	MOR1B
R634	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R635	40-37-8222	FXD C FILM	2.2 OHM 5% 1/2W		
R636	44-91-1100	FXD M OXIDE	100 OHM 5% 1W	HOKURIKU	MOR1B
R637	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R638	42-83-3120	FXD M FILM	12K OHM 1% 1/4W		
R639	42-83-3120	FXD M FILM	12K OHM 1% 1/4W		
R640	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R641	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R642	42-83-2390	FXD M FILM	3.9K OHM 1% 1/4W		
R643	42-83-2910	FXD M FILM	9.1K OHM 1% 1/4W		
R644	40-27-1152	FXD C FILM	150 OHM 5% 1/4W		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A	
R646	40-37-1101	FXD C FILM 100 OHM 5% 1/2W		
RV101	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV102	48-33-1100	VAR M GLAZE 100 OHM B	TEITSU	TM64K3(PV)
RV103	48-33-1500	VAR M GLAZE 500 OHM B	TEITSU	TM64K3(PV)
RV104	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV106	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV107	48-33-1500	VAR M GLAZE 500 OHM B	TEITSU	TM64K3(PV)
RV108	48-33-2100	VAR M GLAZE 1K OHM B	TEITSU	TM64K3(PV)
RV109	48-33-1100	VAR M GLAZE 100 OHM B	TEITSU	TM64K3(PV)
RV110	48-33-2100	VAR M GLAZE 1K OHM B	TEITSU	TM64K3(PV)
RV112	48-33-2200	VAR M GLAZE 2K OHM B	TEITSU	TM64K3(PV)
RV201	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV202	48-33-1100	VAR M GLAZE 100 OHM B	TEITSU	TM64K3(PV)
RV203	48-33-1500	VAR M GLAZE 500 OHM B	TEITSU	TM64K3(PV)
RV204	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV206	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV207	48-33-1500	VAR M GLAZE 500 OHM B	TEITSU	TM64K3(PV)
RV208	48-33-2100	VAR M GLAZE 1K OHM B	TEITSU	TM64K3(PV)
RV210	48-33-2100	VAR M GLAZE 1K OHM B	TEITSU	TM64K3(PV)
RV301	48-33-1200	VAR M GLAZE 200 OHM B	TEITSU	TM64K3(PV)
RV302	48-33-2200	VAR M GLAZE 2K OHM B	TEITSU	TM64K3(PV)
RV606	48-33-2100	VAR M GLAZE 1K OHM B	TEITSU	TM64K3(PV)
S101	80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS	S21P2YC
S102	82-70-8231	LEVER SWITCH	ALPS	SLR823-1
S201	80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS	S21P2YC
S202	82-70-8231	LEVER SWITCH	ALPS	SLR823-1
S301	82-70-8231	LEVER SWITCH	ALPS	SLR823-1
U101	34-00-0111	FET OPE-AMP	N.S	LF356N
U102	30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA	CA3086
U201	34-00-0111	FET OPE-AMP	N.S	LF356N
U202	30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA	CA3086
U301	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U602	34-00-0240	DUAL OPE-AMP	NEC	UPC4558C
U603	34-00-0240	DUAL OPE-AMP	NEC	UPC4558C

A2 ASSEMBLY

C401	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C402	54-40-1200	FXD ELECT 10MF 50WV
C403	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100WV
C404	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C405	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C407	54-40-1200	FXD ELECT 10MF 50WV
C408	54-30-1960	FXD ELECT 47MF 25WV
C409	54-40-1200	FXD ELECT 10MF 50WV
C410	54-30-1960	FXD ELECT 47MF 25WV
C411	55-37-2050	FXD TANT ELECT 1UF 35V
C412	54-30-1970	FXD ELECT 100MF 25WV
C413	50-67-0030	FXD PLSTC FILM 0.01MF 10% 100WV

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A
C414	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C415	54-40-1200	FXD ELECT 10MF 50WV
C416	54-40-1200	FXD ELECT 10MF 50WV
C417	52-06-2165	FXD CER 33PF 10% 500V TYPE1
C418	54-40-1200	FXD ELECT 10MF 50WV
C419	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C420	52-06-2184	FXD CER 47PF 10% 50V TYPE1
C421	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C422	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C423	54-30-1960	FXD ELECT 47MF 25WV
C424	54-40-1200	FXD ELECT 10MF 50WV
C425	52-06-2225	FXD CER 100PF 10% 50V TYPE1
C426	50-65-0530	FXD M PLSTC FILM 1000PF 5% 100WV
C427	50-65-0540	FXD M PLSTC FILM 1UF 5% 100WV
C429	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C430	52-06-2125	FXD CER 15PF 10% 500V TYPE1
C431	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C432	54-40-1200	FXD ELECT 10MF 50WV
C450	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C451	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C501	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C502	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C503	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C504	54-40-1200	FXD ELECT 10MF 50WV
C505	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C506	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C651	54-40-1200	FXD ELECT 10MF 50WV
C652	54-40-1200	FXD ELECT 10MF 50WV
C653	52-01-3425	FXD CER 4700PF 10% 500V TYPE1
C654	50-67-0050	FXD PLSTC FILM 0.047MF 10% 100WV
C655	54-40-1210	FXD ELECT 22MF 50WV
C656	55-37-2050	FXD TANT ELECT 1UF 35V
C657	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C658	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C659	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C660	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C661	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C662	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C663	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C664	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C665	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C666	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C668	52-08-5145	FXD CER 22PF 10% 2KV TYPE1
C669	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100WV
C681	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C682	52-06-2265	FXD CER 220PF 10% 50V TYPE1
C683	54-40-1200	FXD ELECT 10MF 50WV
C684	54-40-1200	FXD ELECT 10MF 50WV
C685	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C687	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C688	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C689	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C690	54-40-1200	FXD ELECT 10MF 50WV
C691	52-02-6345	FXD CER 1000PF 10% 3KV

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
C692	52-96-1170	FXD CER 5PF 1KV		
C693	52-96-1170	FXD CER 5PF 1KV		
C1658	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1		
CR401	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR402	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR403	32-30-0860	DIODE VR=30V IO=30MA	HITACHI	1SS86
CR404	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR405	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR406	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR407	32-30-0860	DIODE VR=30V IO=30MA	HITACHI	1SS86
CR408	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR409	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR410	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR411	32-92-0033	ZENER VZ=3.2 - 3.4V	HITACHI	HZ3C-2
CR412	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR413	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR414	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR415	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR416	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR417	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR418	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR419	32-92-0056	ZENER VZ=5.5 - 5.8V P=0.4W	NEC	RD5.6JB2
CR420	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR421	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR422	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR423	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR424	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR426	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR428	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR429	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR430	40-27-0000	JUMPER PARTS		NAS1/4
CR433	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR501	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR502	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR503	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR504	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR651	32-92-0056	ZENER VZ=5.5 - 5.8V P=0.4W	NEC	RD5.6JB2
CR652	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR653	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR654	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR656	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN	GHV-06SSN
CR657	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR658	32-90-1820	DIODE VR=2KV FAST RECOVERY	HITACHI	ERB26-20
CR659	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR660	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR661	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR662	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR663	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR664	32-30-0830	DIODE VR=250V IO=200MA	HITACHI	1SS83
CR665	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR666	32-92-0022	ZENER VZ=2.1 - 2.3V	HITACHI	HZ2B-3
CR667	32-92-0022	ZENER VZ=2.1 - 2.3V	HITACHI	HZ2B-3
CR668	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
CR669	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR670	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR680	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR681	32-92-0620	ZENER VZ 56 - 68V P=0.5W	TOSHIBA	05Z62
DS651	23-70-0100	LAMP NEON		
DS652	23-70-0100	LAMP NEON		
L401	67-10-0890	INDUCTOR 100MH 10%		
L402	67-10-0921	INDUCTOR 470UH 10%		LAL04NA
L650	67-10-0890	INDUCTOR 100MH 10%		
Q401	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q402	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q403	31-20-1073	FET IDSS=4.5-7.7MA	SONY	2SK107-3
Q404	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q405	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q406	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q407	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q408	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q409	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q410	31-20-1171	FET	TOSHIBA	2SK117-BL
Q411	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q412	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q413	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q414	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q415	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q416	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q417	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q418	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q419	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q420	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q421	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q422	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q423	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q424	30-10-8381	TR SI PNP	MATSUSITA	2SA838-B
Q425	31-20-1171	FET	TOSHIBA	2SK117-BL
Q426	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q427	31-20-1171	FET	TOSHIBA	2SK117-BL
Q428	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q429	30-31-8431	TR SI NPN	NEC	2SC1843-E
Q430	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q431	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q432	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q433	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q434	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q501	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q502	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q503	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q504	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q505	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q506	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q507	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q508	30-10-8441	TR SI PNP	HITACHI	2SA844-D

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A	
Q509	30-20-6481	TR SI PNP	HITACHI	2SB648A
Q510	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q511	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q512	30-20-6481	TR SI PNP	HITACHI	2SB648A
Q651	30-40-8802	TR SI NPN	TOSHIBA	2SD880-Y
Q652	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q654	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q655	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q656	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q657	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q658	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q659	30-40-6681	TR SI NPN	HITACHI	2SD668A-C
Q660	31-20-1171	FET	TOSHIBA	2SK117-BL
R401	40-27-0472	FXD C FILM 47 OHM 5% 1/4W		NAS1/4S
R402	42-83-2100	FXD M FILM 1K OHM 1% 1/4W		
R403	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W		
R404	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R405	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R406	40-27-0472	FXD C FILM 47 OHM 5% 1/4W		NAS1/4S
R407	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R408	40-27-3472	FXD C FILM 47K OHM 5% 1/4W		
R409	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R410	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R411	42-33-0420	FXD M FILM 1M OHM 1% 1/2W		RN1/2S
R412	40-27-0332	FXD C FILM 33 OHM 5% 1/4W		NAS1/4S
R413	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W		
R414	40-27-1562	FXD C FILM 560 OHM 5% 1/4W		
R415	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W		
R416	40-27-0682	FXD C FILM 68 OHM 5% 1/4W		NAS1/4S
R417	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W		
R418	40-27-1562	FXD C FILM 560 OHM 5% 1/4W		
R419	40-27-1562	FXD C FILM 560 OHM 5% 1/4W		
R420	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R421	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R422	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R423	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R424	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R425	40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R426	40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R427	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R428	40-27-3222	FXD C FILM 22K OHM 5% 1/4W		
R429	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R430	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R431	40-27-4472	FXD C FILM 470K OHM 5% 1/4W		
R432	40-27-4472	FXD C FILM 470K OHM 5% 1/4W		
R433	40-27-1562	FXD C FILM 560 OHM 5% 1/4W		
R434	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W		
R435	40-27-0822	FXD C FILM 82 OHM 5% 1/4W		NAS1/4S
R436	40-27-1272	FXD C FILM 270 OHM 5% 1/4W		
R437	40-27-1102	FXD C FILM 100 OHM 5% 1/4W		NAS1/4S
R438	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R439	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R440	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A		
R441	40-27-0102	FXD C FILM	10 OHM 5% 1/4W		NAS1/4S
R442	40-27-0102	FXD C FILM	10 OHM 5% 1/4W		NAS1/4S
R443	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R444	40-27-1332	FXD C FILM	330 OHM 5% 1/4W		
R445	40-27-3122	FXD C FILM	12K OHM 5% 1/4W		
R446	40-27-2562	FXD C FILM	5.6K OHM 5% 1/4W		
R447	40-27-1562	FXD C FILM	560 OHM 5% 1/4W		
R448	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R449	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R450	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R451	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R452	40-27-3472	FXD C FILM	47K OHM 5% 1/4W		
R453	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R454	42-83-3220	FXD M FILM	22K OHM 1% 1/4W		
R455	42-83-3330	FXD M FILM	33K OHM 1% 1/4W		
R456	40-27-2682	FXD C FILM	6.8K OHM 5% 1/4W		
R457	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R458	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R459	40-27-0472	FXD C FILM	47 OHM 5% 1/4W		NAS1/4S
R460	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R461	40-27-1822	FXD C FILM	820 OHM 5% 1/4W		
R462	40-27-3562	FXD C FILM	56K OHM 5% 1/4W		
R463	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R464	40-27-2122	FXD C FILM	1.2K OHM 5% 1/4W		
R465	40-27-2392	FXD C FILM	3.9K OHM 5% 1/4W		
R466	40-27-3182	FXD C FILM	18K OHM 5% 1/4W		
R467	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R468	40-27-4472	FXD C FILM	470K OHM 5% 1/4W		
R469	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R470	40-27-4102	FXD C FILM	100K OHM 5% 1/4W		
R471	40-27-3332	FXD C FILM	33K OHM 5% 1/4W		
R472	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R473	40-27-2472	FXD C FILM	4.7K OHM 5% 1/4W		
R474	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R475	42-83-2160	FXD M FILM	1.6K OHM 1% 1/4W		
R476	40-27-2222	FXD C FILM	2.2K OHM 5% 1/4W		
R477	42-83-2390	FXD M FILM	3.9K OHM 1% 1/4W		
R478	42-83-1470	FXD M FILM	470 OHM 1% 1/4W		
R479	40-27-2332	FXD C FILM	3.3K OHM 5% 1/4W		
R480	42-24-0231	FXD M GLAZE	5M OHM 1% 0.31W		RG08V2F
R481	40-27-2332	FXD C FILM	3.3K OHM 5% 1/4W		
R482	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R483	40-27-2332	FXD C FILM	3.3K OHM 5% 1/4W		
R484	44-25-0001	FXD M GLAZE	R-NET	KIKUSUI	TNB13T0006
R485	44-07-0190	FXD M GLAZE	R-NET 10K OHM X10		
R486	42-83-2160	FXD M FILM	1.6K OHM 1% 1/4W		
R487	40-27-1682	FXD C FILM	680 OHM 5% 1/4W		
R488	40-27-1222	FXD C FILM	220 OHM 5% 1/4W		
R489	40-27-0682	FXD C FILM	68 OHM 5% 1/4W		NAS1/4S
R490	40-27-2102	FXD C FILM	1K OHM 5% 1/4W		
R492	40-27-1102	FXD C FILM	100 OHM 5% 1/4W		NAS1/4S
R493	40-27-2682	FXD C FILM	6.8K OHM 5% 1/4W		
R499	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		
R500	40-27-3102	FXD C FILM	10K OHM 5% 1/4W		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A
R501	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R502	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R503	42-83-0560	FXD M FILM 56 OHM 1% 1/4W	
R504	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R505	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R506	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R507	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R508	42-83-2100	FXD M FILM 1K OHM 1% 1/4W	
R509	42-83-2100	FXD M FILM 1K OHM 1% 1/4W	
R510	42-83-2100	FXD M FILM 1K OHM 1% 1/4W	
R511	42-83-2100	FXD M FILM 1K OHM 1% 1/4W	
R512	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R513	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R514	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R515	42-83-4100	FXD M FILM 100K OHM 1% 1/4W	
R516	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R517	42-83-4100	FXD M FILM 100K OHM 1% 1/4W	
R518	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R519	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R520	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R521	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R522	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	NAS1/4S
R523	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R524	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R525	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	NAS1/4S
R530	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R531	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R652	42-83-3120	FXD M FILM 12K OHM 1% 1/4W	
R653	42-83-2820	FXD M FILM 8.2K OHM 1% 1/4W	
R654	42-83-3680	FXD M FILM 68K OHM 1% 1/4W	
R655	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R656	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	NAS1/4S
R657	44-91-8101	FXD M OXIDE 1 OHM 5% 1W	MATSUSITA ERX1ANJ
R658	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R659	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R660	40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
R661	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R662	42-44-0330	FXD T FILM 10M OHM 1% 1W	
R663	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R664	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R665	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R666	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R667	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R668	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R670	40-27-3822	FXD C FILM 82K OHM 5% 1/4W	
R671	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R673	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R674	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R675	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R677	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R678	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	NAS1/4S
R679	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	NAS1/4S
R680	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R681	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A	
R682	40-27-0000	JUMPER PARTS		NAS1/4
R683	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R684	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R685	40-27-1122	FXD C FILM 120 OHM 5% 1/4W		
R686	40-27-1222	FXD C FILM 220 OHM 5% 1/4W		
R687	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W		
R688	40-27-1332	FXD C FILM 330 OHM 5% 1/4W		
R689	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W		
R690	40-37-3471	FXD C FILM 47K OHM 5% 1/2W		
R691	40-37-3471	FXD C FILM 47K OHM 5% 1/2W		
R692	40-37-3471	FXD C FILM 47K OHM 5% 1/2W		
R693	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R694	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R695	40-37-3471	FXD C FILM 47K OHM 5% 1/2W		
R697	40-27-1152	FXD C FILM 150 OHM 5% 1/4W		
R698	40-27-4222	FXD C FILM 220K OHM 5% 1/4W		
R1652	40-27-3182	FXD C FILM 18K OHM 5% 1/4W		
R1654	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W		
RV401	48-33-2500	VAR M GLAZE 5K OHM B	TEITSU	TM64K3(PV)
RV402	48-33-4500	VAR M GLAZE 500K OHM B	TEITSU	TM64K3(PV)
RV403	48-33-3100	VAR M GLAZE 10K OHM B	TEITSU	TM64K3(PV)
RV651	48-26-5220	VAR M GLAZE 2.2M OHM		
RV652	48-33-4100	VAR M GLAZE 100K OHM B	TEITSU	TM64K3(PV)
RV653	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
S401	82-70-5231	LEVER SWICH		
S402	82-70-5242	LEVER SWITCH	ALPS	SLR524-2
S403	82-70-5222	PUSH SWITCH	ALPS	SLR522-2
S404	80-98-0700	SWEEP-2 ROTARY	316561	
T651	63-92-0180	DC-DC CON TRANS HV-5	KIKUSUI	S8512012
U401	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U402	35-70-1123	DUAL J-K F-F WITH P/C	HITACHI	HD74LS112P
U403	34-00-0215	J-FET INPUT OPE-AMP	TEXAS INS.	TL081CP
U404	34-69-0030	TRIPLE 2-CHANNEL MULTIPLEXER	TOSHIBA	TC4053BP
U405	34-69-0080	TRIPLE 8-CHANNEL MULTIPLEXER	TOSHIBA	TC4051BP
U406	35-70-1481	OCTAL PRIORITY ENCODERS	HITACHI	HD74LS148P
U407	35-19-2080	TR-ARRAY	TOSHIBA	TD62504P
U408	35-19-2080	TR-ARRAY	TOSHIBA	TD62504P
U409	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U651	34-00-0215	J-FET INPUT OPE-AMP	TEXAS INS.	TL081CP

A3 ASSEMBLY

C452	52-01-3345	FXD CER 1000PF 10% 500V TYPE2		
C453	52-01-3345	FXD CER 1000PF 10% 500V TYPE2		
C460	54-20-1150	FXD ELECT 3900MF 16WV		
C461	52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2		
C463	54-20-1170	FXD ELECT 1000MF 16WV		KME16VB
C464	52-06-2245	FXD CER 150PF 10% 50V TYPE1		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
C465	54-30-1970	FXD ELECT 100MF 25WV		
C466	52-06-2265	FXD CER 220PF 10% 50V TYPE1		
CR427	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR450	32-90-2110	DIODE BRIGE VRM=400V IO=1A	TOSHIBA	1G4B42
CR451	32-90-2420	DIODE BRIGE VRM=40V IO=8A	N.INTER	C8P04Q
CR452	32-91-1805	ZENER VZ=5.48-5.76V P=0.4W	NEC	RD5.6JSB2
L410	67-10-1490	INDUCTOR 125UH		FN-8D-50
L411	67-10-1490	INDUCTOR 125UH		FN-8D-50
Q440	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q441	30-10-4731	TR SI PNP	TOSHIBA	2SA473-Y
R1401	40-16-2821	FXD C FILM 8.2K OHM 5% 1/6W		RD1/6FS
R1402	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1403	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1404	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1405	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1406	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1407	44-07-0190	FXD M GLAZE R-NET 10K OHM X10		
R1408	40-16-2101	FXD C FILM 1K OHM 5% 1/6W		RD1/6FS
R1409	40-16-2101	FXD C FILM 1K OHM 5% 1/6W		RD1/6FS
R1410	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1411	43-58-0390	FXD WW 0.15 OHM 10% 2W		RGC2T
R1412	40-16-1471	FXD C FILM 470 OHM 5% 1/6W		RD1/6FS
R1413	40-16-1471	FXD C FILM 470 OHM 5% 1/6W		RD1/6FS
R1414	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R1415	42-80-2391	FXD M FILM 3.9K OHM 1% 1/6W		RN1/6FS
R1416	42-80-2121	FXD M FILM 1.2K OHM 1% 1/6W		RN1/6FS
RV406	45-01-0550	VAR C COMP 10K/100K OHM B		
S405	81-03-0270	PUSH SWITCH	ALPS	SUE30
S406	81-05-0250	PUSH SWITCH	KIKUSUI	S8504661
S408	80-98-0810	SWITCH	ALPS	
U410	34-40-0400	REGULATOR (SWITCHING)	TEXAS INS.	TL497AC

A4 ASSEMBLY

C1605	50-45-0500	FXD PLSTC FILM 0.01MF 5% 50WV		
C1606	50-45-0500	FXD PLSTC FILM 0.01MF 5% 50WV		
C1607	52-06-2051	FXD CER 5P 10% 50V TYPE1		
C1608	52-01-3345	FXD CER 1000PF 10% 500V TYPE2		
C1609	54-30-1960	FXD ELECT 47MF 25WV		
C1610	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2		
CR1601	32-91-2300	ZENER VZ=135 - 165V P=1W	TOSHIBA	1Z150
CR1605	37-00-0061	LAMP LED GREEN	TOSHIBA	TLG145
DS1601	23-44-0000	LAMP FILAMENT 14V 80MA		

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
DS1602		23-44-0000	LAMP FILAMENT 14V 80MA		
Q1601		30-31-8461	TR SI NPN	MATSUSITA	2SC1846-R
Q1602		30-31-8461	TR SI NPN	MATSUSITA	2SC1846-R
R1601	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R1602		40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R1603		40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R1604		40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R1605		40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R1606		40-27-4222	FXD C FILM 220K OHM 5% 1/4W		
R1607		40-27-4472	FXD C FILM 470K OHM 5% 1/4W		
R1608		40-27-4472	FXD C FILM 470K OHM 5% 1/4W		
R1609		40-27-1472	FXD C FILM 470 OHM 5% 1/4W		
R1610		42-83-3120	FXD M FILM 12K OHM 1% 1/4W		
R1611		40-27-3682	FXD C FILM 68K OHM 5% 1/4W		
R1612		42-83-1470	FXD M FILM 470 OHM 1% 1/4W		
R1613		40-27-0102	FXD C FILM 10 OHM 5% 1/4W		NAS1/4S
R1614		40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R1615		40-27-1102	FXD C FILM 100 OHM 5% 1/4W		NAS1/4S
R1616		40-27-1562	FXD C FILM 560 OHM 5% 1/4W		
R1617		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W		
R1618		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W		
RV1601		45-44-3101	VAR C COMP 10K OHM B	KIKUSUI	V16L6SN15K
RV1603		45-44-4201	VAR C COMP 200K OHM B	KIKUSUI	V16L6SN15K
RV1604		45-43-2200	VAR M GLAZE 2K OHM		
RV1605		45-44-3101	VAR C COMP 10K OHM B	KIKUSUI	V16L6SN15K
RV1606		45-43-3100	VAR M GLAZE 10K OHM		
S1601		81-01-0270	PUSH SWITCH	ALPS	SDG5P-E
U1601		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA	TC4011BP

A5 ASSEMBLY

C801		54-40-1200	FXD ELECT 10MF 50WV		
C802		54-40-1200	FXD ELECT 10MF 50WV		
C803		50-67-0050	FXD PLSTC FILM 0.047MF 10% 100WV		
C804		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C805		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C806		54-40-1200	FXD ELECT 10MF 50WV		
C807		52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C808		52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C809		52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C810		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C811		54-40-1200	FXD ELECT 10MF 50WV		
C812		52-01-3385	FXD CER 2220PF 10% 500V TYPE2		
C814		52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C816		52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C817		55-37-2050	FXD TANT ELECT 1UF 35V		
C818		55-37-2050	FXD TANT ELECT 1UF 35V		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
C819	50-67-0010	FXD PLSTC FILM 0.0022MF 10% 100WV		
C821	52-06-2165	FXD CER 33PF 10% 500V TYPE1		
C822	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C823	54-40-1200	FXD ELECT 10MF 50WV		
C824	54-40-1200	FXD ELECT 10MF 50WV		
C825	54-40-1200	FXD ELECT 10MF 50WV		
C826	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C827	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C828	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C829	52-06-2184	FXD CER 47PF 10% 50V TYPE1		
C830	55-37-2050	FXD TANT ELECT 1UF 35V		
C831	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C832	54-40-1210	FXD ELECT 22MF 50WV		
C833	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C834	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C835	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C836	55-37-2050	FXD TANT ELECT 1UF 35V		
C837	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C838	52-06-2215	FXD CER 82PF 10% 500V TYPE1		
C839	54-30-1970	FXD ELECT 100MF 25WV		
C840	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C841	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C842	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C843	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C844	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C845	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C847	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C848	52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C849	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C850	52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C851	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C852	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C853	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C854	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C855	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C856	52-06-2274	FXD CER 270P 10% 50V TYPE1		
C857	52-06-2204	FXD CER 68P 10% 50V TYPE1		
C858	54-30-1970	FXD ELECT 100MF 25WV		
C859	54-30-1970	FXD ELECT 100MF 25WV		
C860	54-30-1970	FXD ELECT 100MF 25WV		
C861	52-06-2145	FXD CER 22PF 10% 500V TYPE1		
CR801	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR802	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR803	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR804	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR805	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR806	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR807	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR808	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR809	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR810	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR811	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR812	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
CR813	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR815	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR816	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR817	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR818	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR819	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR820	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
Q801	30-31-9071	TR SI NPN	HITACHI	2SC1907
Q802	30-10-8441	TR SI PNP	HITACHI	2SA844-D
Q803	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q804	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q805	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q806	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q807	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q808	30-11-0151	TR SI PNP	TOSHIBA	2SA1015-Y
Q809	30-30-9451	TR SI NPN	NEC	2SC945-Q
Q810	30-30-9451	TR SI NPN	NEC	2SC945-Q
R801	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R802	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R803	40-27-3472	FXD C FILM 47K OHM 5% 1/4W		
R804	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W		
R805	42-83-3120	FXD M FILM 12K OHM 1% 1/4W		
R806	42-83-2820	FXD M FILM 8.2K OHM 1% 1/4W		
R807	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R808	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R809	42-83-2330	FXD M FILM 3.3K OHM 1% 1/4W		
R810	42-83-4100	FXD M FILM 100K OHM 1% 1/4W		
R811	40-27-3182	FXD C FILM 18K OHM 5% 1/4W		
R812	40-27-1822	FXD C FILM 820 OHM 5% 1/4W		
R813	42-83-2270	FXD M FILM 2.7K OHM 1% 1/4W		
R814	42-83-2270	FXD M FILM 2.7K OHM 1% 1/4W		
R815	40-27-1222	FXD C FILM 220 OHM 5% 1/4W		
R816	40-27-1222	FXD C FILM 220 OHM 5% 1/4W		
R817	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R818	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W		
R819	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W		
R820	42-83-1180	FXD M FILM 180 OHM 1% 1/4W		
R821	40-27-3822	FXD C FILM 82K OHM 5% 1/4W		
R822	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R824	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R825	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R826	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R827	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R828	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R829	42-83-1120	FXD M FILM 120 OHM 1% 1/4W		
R830	42-83-1120	FXD M FILM 120 OHM 1% 1/4W		
R831	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R832	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W		
R833	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W		
R834	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W		
R835	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W		
R836	40-27-3472	FXD C FILM 47K OHM 5% 1/4W		

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A	
R837	40-27-1222	FXD C FILM 220 OHM 5% 1/4W		
R838	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W		
R839	40-27-1822	FXD C FILM 820 OHM 5% 1/4W		
R840	40-27-3272	FXD C FILM 27K OHM 5% 1/4W		
R841	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R842	40-27-1682	FXD C FILM 680 OHM 5% 1/4W		
R843	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R844	40-27-1472	FXD C FILM 470 OHM 5% 1/4W		
R845	40-27-5102	FXD C FILM 1M OHM 5% 1/4W		
R846	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R847	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W		
R848	40-27-3222	FXD C FILM 22K OHM 5% 1/4W		
R849	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R850	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R851	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R852	40-27-3472	FXD C FILM 47K OHM 5% 1/4W		
R853	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R854	40-27-4102	FXD C FILM 100K OHM 5% 1/4W		
R855	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W		
R856	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R857	40-27-2102	FXD C FILM 1K OHM 5% 1/4W		
R858	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W		
R859	40-27-3102	FXD C FILM 10K OHM 5% 1/4W		
R860	40-27-1222	FXD C FILM 220 OHM 5% 1/4W		
R861	40-27-0472	FXD C FILM 47 OHM 5% 1/4W		NAS1/4S
RV801	48-33-2500	VAR M GLAZE 5K OHM B	TEITSU	TM64K3(PV)
RV802	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV803	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
RV804	48-33-1500	VAR M GLAZE 500 OHM B	TEITSU	TM64K3(PV)
RV806	48-33-2200	VAR M GLAZE 2K OHM B	TEITSU	TM64K3(PV)
RV807	48-33-3200	VAR M GLAZE 20K OHM B	TEITSU	TM64K3(PV)
U801	34-00-0340	FET INPUT DUAL OP AMP	TEXAS INS.	TL082CP
U802	34-00-0340	FET INPUT DUAL OP AMP	TEXAS INS.	TL082CP
U803	36-20-0080	D/A CONVERTER 8BIT	HITACHI	HA17408P
U804	36-30-0130	A/D CONVERTOR 8 BIT	N.S	ADC0820BCN
U805	36-30-0130	A/D CONVERTOR 8 BIT	N.S	ADC0820BCN
U806	34-00-0270	DUAL OP-AMP	N.S	LF353N
U810	35-70-1611	SYNCHRONOUS 4BIT COUNTER	HITACHI	HD74LS161P
U811	35-70-1611	SYNCHRONOUS 4BIT COUNTER	HITACHI	HD74LS161P
U812	35-70-1611	SYNCHRONOUS 4BIT COUNTER	HITACHI	HD74LS161P
U813	35-70-0321	QUAD 2-INPUT POSI-OR	TEXAS INS.	SN74LS32N
U814	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U815	35-70-0321	QUAD 2-INPUT POSI-OR	TEXAS INS.	SN74LS32N
U816	35-70-0047	HC-MOS HEX INVERTER	N.S	MM74HC04N
U820	35-70-1573	QUAD 2-TO-1 DATA SELECTORS	HITACHI	HDLS157P
U821	35-70-1573	QUAD 2-TO-1 DATA SELECTORS	HITACHI	HDLS157P
U822	35-70-1573	QUAD 2-TO-1 DATA SELECTORS	HITACHI	HDLS157P
U823	35-70-0083	QUAD 2-INPUT POSI-AND	HITACHI	HDLS08P
U824	35-70-1123	DUAL J-K F-F WITH P/C	HITACHI	HD74LS112P
U825	35-70-0083	QUAD 2-INPUT POSI-AND	HITACHI	HDLS08P
U826	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U827	35-70-1617	C-MOS SYNC 4BIT COUNTER	N.S	MMHC161P

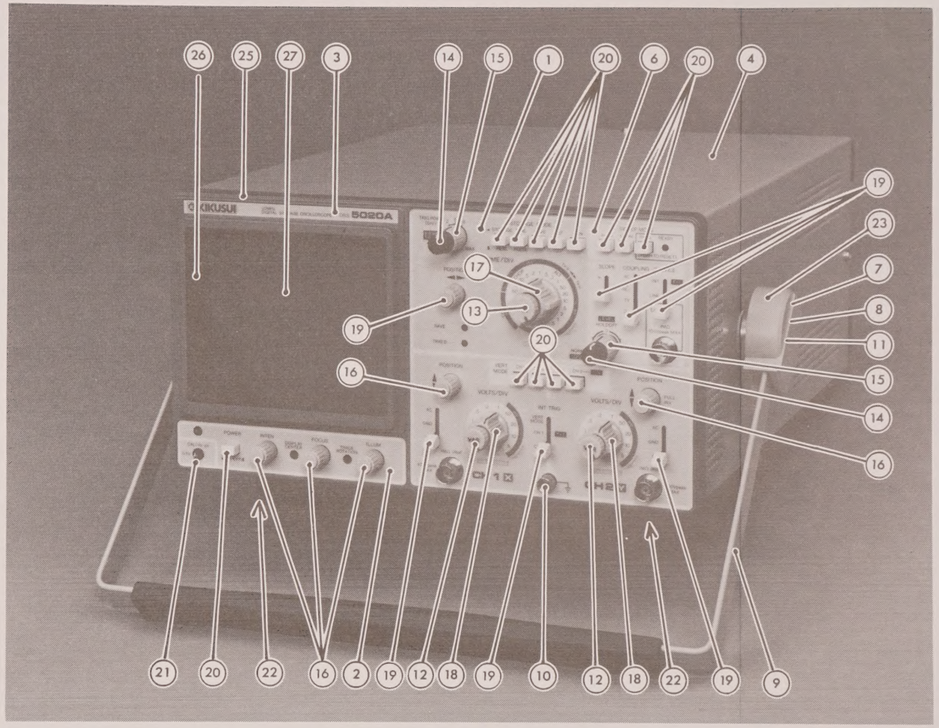
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION DSS 5020A		
U828	34-20-0110	SYSTEM RESETTING IC	MISTUMI	PST518A
U830	35-56-0110	S-RAM 2K X 8BIT 120NS	HITACHI	HM6116/P-2
U831	35-59-0020	EPROM 8KX8BIT 250NS	HITACHI	HN462764/G
U832	36-90-0120	Z80A-CTC 4MHZ	SHARP	LH0082
U833	36-90-0110	Z80A-CPU 4MHZ	SHARP	LH0080A
U840	35-70-2451	OCTAL BUS TRANSCEIVER	HITACHI	HD74LS245P
U841	35-56-0100	S-RAM 8KW X 8BIT 150NS	HITACHI	HM6264P-15
U842	36-90-0120	Z80A-CTC 4MHZ	SHARP	LH0082
U843	36-90-0130	Z80-DMA 4MHZ	SHARP	LH0083A
U850	35-70-5411	OCTAL BUFFER	TEXAS INS.	SN74LS541N
U851	35-70-1531	DUAL 4-TO-1 DATA SELECTORS	TEXAS INS.	SN74LS153N
U852	35-70-2733	OCTAL LATCH	HITACHI	HD74LS273P
U853	35-70-0743	DUAL D F-F EDGE TRIGGER	HITACHI	HD74LS74P
U854	35-70-0321	QUAD 2-INPUT POSI-OR	TEXAS INS.	SN74LS32N
U855	35-70-1381	3LINE TO 8LINE DECORDER	HITACHI	HD74LS138P
U856	35-70-1381	3LINE TO 8LINE DECORDER	HITACHI	HD74LS138P
U860	35-70-5411	OCTAL BUFFER	TEXAS INS.	SN74LS541N
U861	35-70-0743	DUAL D F-F EDGE TRIGGER	HITACHI	HD74LS74P
U862	35-70-0321	QUAD 2-INPUT POSI-OR	TEXAS INS.	SN74LS32N
U863	35-70-1123	DUAL J-K F-F WITH P/C	HITACHI	HD74LS112P
U864	35-70-0008	QUAD 2-INPUT NAND	HITACHI	HD74LS00P
U865	35-70-1123	DUAL J-K F-F WITH P/C	HITACHI	HD74LS112P
U866	35-70-1232	DUAL RETRIGGER MONO-MULTI	HITACHI	HD74LS123P
X801	93-00-0180	QUARTS HC-49/U 8MHZ	KIKUSUI	S8409201
A7 ASSEMBLY				
CR320	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
CR321	32-30-1200	DIODE VR=60V IO=1A	HITACHI	1SS120
R380	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
R381	40-16-3101	FXD C FILM 10K OHM 5% 1/6W		RD1/6FS
RV111	45-35-3108	VAR C COMP 10K OHM		V16L4SN15KC
RV211	45-01-0681	VAR C COMP 10K OHM WITH SW		V16L4SN15KC
S302	81-04-0250	PUSH SWITCH	ALPS	SUE40
A9 ASSEMBLY				
C901	54-40-1200	FXD ELECT 10MF 50WV		
C902	54-40-1200	FXD ELECT 10MF 50WV		
C903	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C904	52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C905	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C906	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2		
C907	52-06-2225	FXD CER 100PF 10% 50V TYPE1		
C908	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		
C909	52-37-1000	FXD CER 0.047UF 20% 25V TYPE1		

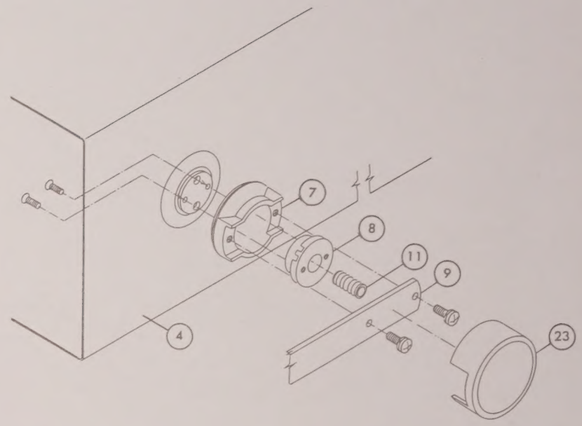
REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	DSS 5020A	
CR901		32-92-0027	ZENER VZ=2.5 - 2.8V	HITACHI	HZS-2.7EB1
R901		42-80-2101	FXD M FILM 1K OHM 1% 1/6W		RN1/6FS
R902		40-16-2101	FXD C FILM 1K OHM 5% 1/6W		RD1/6FS
R903	*	40-16-1221	FXD C FILM 220 OHM 5% 1/6W		RD1/6FS
R904		42-80-2201	FXD M FILM 2K OHM 1% 1/6W		RN1/6FS
R905		42-80-1391	FXD M FILM 390 OHM 1% 1/6W		RN1/6FS
R906		42-80-2101	FXD M FILM 1K OHM 1% 1/6W		RN1/6FS
R907		40-16-2101	FXD C FILM 1K OHM 5% 1/6W		RD1/6FS
R908		42-80-1391	FXD M FILM 390 OHM 1% 1/6W		RN1/6FS
R909		40-16-0471	FXD C FILM 47 OHM 5% 1/6W		RD1/6FS
R910		40-16-1221	FXD C FILM 220 OHM 5% 1/6W		RD1/6FS
R911		40-16-1221	FXD C FILM 220 OHM 5% 1/6W		RD1/6FS
R912		40-16-1471	FXD C FILM 470 OHM 5% 1/6W		RD1/6FS
R913		40-16-5101	FXD C FILM 1M OHM 5% 1/6W		RD1/6FS
R914		40-16-5101	FXD C FILM 1M OHM 5% 1/6W		RD1/6FS
R915		40-16-5101	FXD C FILM 1M OHM 5% 1/6W		RD1/6FS
U901		35-70-0321	QUAD 2-INPUT POSI-OR	TEXAS INS.	SN74LS32N
U902		35-70-3747	OCTAL D-TYPE F/F	HITACHI	HD74LS374P
U903		35-70-3747	OCTAL D-TYPE F/F	HITACHI	HD74LS374P
U904		35-70-1741	HEX D-TYPE FLIP FLOP	TEXAS INS.	SN74LS174N
U905		36-20-0080	D/A CONVERTER 8BIT	HITACHI	HA17408P
U906		36-20-0080	D/A CONVERTER 8BIT	HITACHI	HA17408P
U907		34-00-0340	FET INPUT DUAL OP AMP	TEXAS INS.	TL082CP

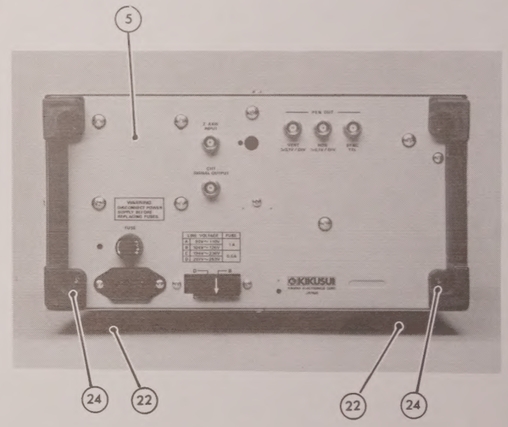
B8 ASSEMBLY

DSS 5020A

NO.	CODE	DESCRIPTION	REMARK
1	A1-510-701	FRONT PANEL	
2	A1-510-702	FRONT PANEL (CRT)	
3	A8-510-701	NAME PLATE DSS 5020A	
4	B2-510-501	CASE	
5	B6-510-701	PLATE REAR	REAR
6	C1-510-001	SUB PANEL	BEHIND FRONT PANEL
7	E6-050-061	HANDLE STOPPER-1	
8	E6-050-071	HANDLE STOPPER-2	
9	E6-510-501	CARRYING HANDLE	
10	L4-510-001	GND TERMINAL	
11	L5-050-011	SPRING (FOR HANDLE)	
12	N1-510-003	KNOB R12W (205) -VAR	
13	N1-510-004	KNOB R14W (205) -VAR	
14	N1-510-005	KNOB R11W (525) -3.2	
15	N1-510-006	KNOB R13W (YR)	
16	N1-510-008	KNOB R11S (YR) -K	REAR
17	N1-510-010	KNOB D22W (YR)	
18	N1-510-011	KNOB D18W (YR)	
19	N9-510-001	KNOB FOR LEVER SWITCH	
20	N9-510-002	PUSH BUTTON	
21	P2-000-291	CAL TERMINAL	
22	P2-000-381	FOOT (20-17)	BOTTOM
23	P2-510-002	CAP (HANDLE)	
24	P3-510-001	CORD HOLDER	REAR
25	P9-510-001	FRONT FRAME	
26	P9-510-002	BEZEL	
27	S4-510-001	FILTER (GRAY)	







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